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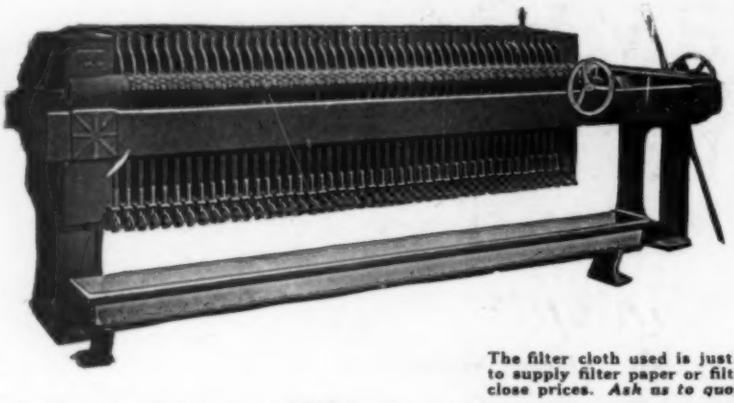

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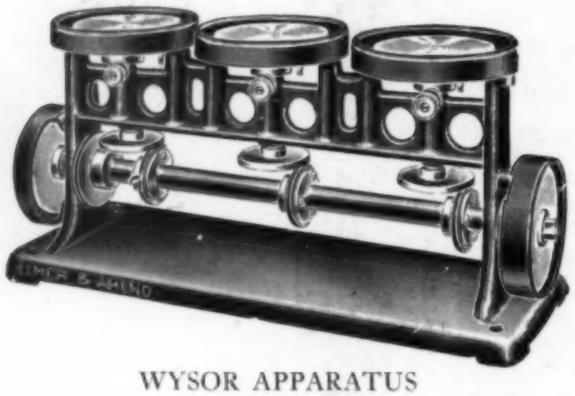

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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
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Volume 27 — New York, October 18, 1922 — Number 16

One Chemical Exposition, or Two?

PRESENT indications are that two chemical expositions will bid for the favor and patronage of the chemical industry in 1923. As intimated in our editorial comment of September 27, a rival exposition was proposed even before the Eighth National Exposition of Chemical Industries was closed. And now the new project has been formally launched as the Chemical Industries Exposition, sponsored in its organization by ADRIAAN NAGELVOORT. Briefly, it is based on the co-operative principle, the exhibitors being *ipso facto* members. A board of directors is to manage the business.

Holding no brief for any particular exposition company or organization, and having in mind only the best interests of the industry, we are glad to give space elsewhere in this issue to a statement by Mr. NAGELVOORT in which he gives the reasons, as he sees them, that call for an exposition modeled on new lines. With much that he says we are in hearty accord. An exposition management should be in lively contact with the exhibitors, and the chemical industries *per se* should be well represented in a chemical exposition. Further, the chemical industry still needs an exposition as a great educational force in driving home the interrelation and interdependence of its constituent parts, and its bearing as a whole on the national welfare.

Following Mr. NAGELVOORT thus far, we come to a point of divergent opinion when he holds that a co-operative body is essential to a well-rounded, successful exposition, and that a commercial enterprise under professional management cannot, or is not likely to, achieve this end. There is room for a difference of opinion, because there are successful co-operative expositions, although they are conducted along slightly different lines than those hitherto adopted in the National Exposition of Chemical Industries. Our own opinion has been previously expressed on two occasions, following the seventh and eighth expositions respectively. And thus far we see no reason for changing our fundamental position. Mr. NAGELVOORT may prove us wrong, but as a matter of policy we should prefer to labor with the present management in an effort to improve its methods and results, rather than force a division of the industry by opening a rival show. This would seem to be the part of wisdom, at least until the present management proves so utterly incompetent, or so stiff-necked and obstinate, as to make success impossible. And since, in our judgment, we have not begun to approach that point, we deprecate the possibility of two expositions.

For eight years the chemical show has been an annual affair. The current intervening year is still young, and no man can foresee what it will bring forth. Is it hopeless to believe that subsequent events will point the way to a unification of interests and a happy acceptance of ideas that will give us one great exposition representative of the chemical industry of the United States? We think not.

European Conditions As We See Them

WORD pictures of conditions in Europe have almost become the order of the day. With each returning ship fresh travelers add either to the clarity or confusion of ideas, according as their experience has been deep or casual, biased or disinterested. Each attempts, and no doubt achieves a measure of success in his efforts, to portray conditions as he saw them; but the criterion of the value of his conclusions must be the facilities he enjoyed for observation, the extent to which he was able to delve beneath the superficial aspect of affairs and fortify his judgment with essential and significant facts.

At the risk of adding one more note to the concert of American opinion on Europe, but with confidence that it will prove enlightening as well as harmonious, we begin publication in this issue of a series of short articles, impressions of European conditions, by Mr. J. S. NEGRU, Managing Editor of *Chem. & Met.* For six months, from February to August of this year, he traveled the central European countries, Belgium, France, Italy, Switzerland and Germany, as a representative of this magazine for the purpose of learning at first hand the facts in the technical, economic and social affairs of those countries. Our purpose was to afford the business and professional clientèle of *Chem. & Met.* an opportunity to view through an engineer's eyes the things about which merchants, bankers, economists and other groups of our population had been writing from their respective points of view. There is value and advantage in getting opinions on moot questions from one having the same background and fundamental training as ourselves. There is confidence in the methods of observation and the processes of deduction—a feeling that various factors have been properly evaluated so that the final conclusions are comparable to those which we ourselves would have reached under similar circumstances and with similar opportunities.

A significant fact in the outcome of Mr. NEGRU'S trip is that while he set out hopeful of obtaining much in the way of new technical information, of research, of new and improved products and processes, the field proved so barren in this respect as to have yielded little or no fruit. On the contrary, he found European industry so deeply involved in economic distress as to lead him almost to abandon the search for technical matters and turn his attention to the business and financial situation as it affects personnel, processes and

products in the chemical and related industries in Europe, and incidentally in this country. This aspect, then, will characterize the articles which we hope will prove helpful in getting a correct view of European conditions.

Recognizing a Community of Interest

SOME waning of interest in the Chemical Warfare Service is becoming manifest even within the chemical industry itself. Just as those who live behind levees are inclined to forget about floods when the river is low and neglect protective measures, so it is, observers in Washington point out, with the work of the Chemical Warfare Service in peace time. It is thoroughly understood that such a tendency is the natural one. It applies to all branches of the military service. The Ordnance Department, for instance, is having the greatest difficulty to induce manufacturers to co-operate in the design of their materiel so that equipment may be planned that offers the minimum of manufacturing difficulties.

As to the Chemical Warfare Service, however, there is a feeling that the chemical industry should be careful to keep alive its co-operation and to maintain all its contacts with the organization. This is regarded as imperative, since the Chemical Warfare Service has not been thoroughly "sold" to the American public. More than that, the industry is under particular obligations to the Chemical Warfare Service, since its officers boldly took a course in defense of the dye embargo which was known to be unpopular with a majority of the members of Congress—the body to which the Chemical Warfare Service must look for its funds and for its very existence. In view of that disregard of its own selfish interest, there is a feeling that the chemical industry should be unusually observing in keeping alive its co-operation with the Chemical Warfare Service in an effort to solve its problems.

Chemical Imports And Reparations

PERSISTENT reports by the newspapers that chemicals would be accepted on the reparations account have caused a stir which now appears to have been wholly unjustified by the real facts in the situation. Nevertheless this bogey will doubtless bob up again at intervals as some enterprising newspaper man runs onto a new angle or a new possibility of the story. It is worth while, therefore, to have clearly in mind a few of the facts involved.

The State Department has unquestionably been considering the proposal that the government be paid for the expense of maintaining the American army of occupation in Germany by means of imported dyes and chemicals. The amount due the United States is approximately $250,000,000. If that debt be regarded as interest-bearing and 4 per cent be assumed as a cost of money to the government, then $10,000,000 per year will have to be paid on account simply to keep up the interest. To make any appreciable inroads on the principal would require several times that sum annually.

In the past, import of dyes and chemicals through the Textile Alliance was made without direct participation of the government. The government simply sanctioned the proceedings and handled none of the money or commodity. The new proposal would necessitate either money or commodity or both being handled by the government at some stage of the proceeding. There is at first sight no legal ground for entry of the government upon such a proceeding without specific additional approval through new legislation by Congress. Furthermore, to permit such import would be contrary to the entire spirit of a protective tariff policy. Therefore, if Congress should be asked and should grant permission for establishing such an importing agency, it doubtless would be limited to one that could bring into the United States such dyes or chemicals as would not compete with domestic products. But if one limits the import to non-competitive commodities, then the quantities involved would be small. Estimates as to how small they would be vary considerably, but no one seems to feel that the amount would be greater than three or four million dollars per year and, what is more probable, only about one million dollars per year.

Considering these figures, it is evident that no material progress can be made in payment of reparation accounts by the import of chemicals unless an entire change in our foreign trade policy is adopted by Congress, or by the State Department without the consent of Congress. In view of these facts, there is certainly nothing alarming about the rumors even though they seem to have very credible source and backing.

We should not lose sight of the fact that the appointing of an import agency might establish precedent for the importation of other commodities than dyes and fine synthetic organic chemicals. There is no doubt that this country will eventually have to take its payment for the expenses of the army of occupation in commodities, for it is not conceivable that we would be granted any cash payment while other reparation accounts for Belgium, France and other European countries remain unpaid. There will be great temptation, therefore, for legislative and administrative officials who desire to make a good financial showing for government affairs to look forward to some arrangement for the regulated import from Germany of commodities the sale price of which can be credited to the United States Government instead of going to the German exporter. This is a tendency and a possibility which deserve careful study. That there is likely to be any such development seems improbable, but in forecasting future developments it is worth while to consider even so remote a contingency as this.

Making Use of Facts and Figures

BUSINESS judgment in the long run can be no better than the information on which it is based. This simple truth is the real evidence on which that very practical scientist HENRY S. DENNISON is willing to rest the case of "Facts and Figures" vs. "Hump and Hunch." In a talk last week before the National Conference of Business Paper Editors he gave it as his opinion that many of the hard-headed old fellows who have opposed the scientific management of industry and the use of facts and figures really carry around just this sort of data with them and don't know it. Their "hunches" are based, in a sort of subconscious way, on sound knowledge and ripe experience tucked away somewhere in the backs of their heads. Charts and graphs, they say, will eliminate judgment and make business merely the Punch-and-Judy show of automatons. On the contrary, Mr. DENNISON avers that these facts and figures are

responsible for the most exacting demands on judgment. It is when a man is in possession of all the facts in a case that he is most likely to ponder the consequences of his decision.

Take, for instance, the problem of facilities. How do you know when to order machinery, or additional equipment, or a new building? Right now you may be badly in need of one of these things, but how about six months or a year from now when the piece is installed or the building completed? Here it is that the executive with definite knowledge of his business, of its normal line of growth and of the records of the past and present industrial situation can gage his purchase with precision and foresight.

The past is our only yardstick for measuring the future, and it can be put to work in no more useful way than in helping to solve the problems of buying and selling. The long-time price curve of a commodity plotted along with warehouse stocks is a most reliable guide to the buyer. He needs but to establish some median line of "normalcy" and when prices are above that line to buy relatively less, when prices are below the median line to buy relatively more. Such a policy consistently pursued must mean a dollars-and-cents saving to the buyer. Furthermore, it relieves him of that strain which accompanies the frantic endeavor to find the exact bottom of the market or, what is more comforting, he avoids the disastrous tumble from the top.

Business, because it is such a multifarious thing, can never be charted with the certainty and fairness of an engineering project. There will always remain breaches and gaps which will not be bridged by facts and figures. Labor policies, employee selection, promotion, etc., are instances in which we must always lean heavily on human judgment and appraisal. But even if our data are fragmentary and incomplete, it is no reason why we should not use what we have to best advantage. The physician knows but a surprisingly small fraction of the fundamental facts of health and disease, yet it is on the judicious utilization of these facts that the medical profession has made its remarkable progress. The government, the trade associations and other agencies are at work gathering data, the completeness of which will depend in the last analysis on whether or not it is put to practical use. Are you, as an individual, making the most use of the facts and figures of your business? If not, you are the loser.

The Coal Users' Part

IT WILL not be coal production but rather coal transportation that will limit fuel supply during the coming winter. It is almost certain, even with an open winter, that there will be distressing shortages at some points and if we have a severe winter the shortage will be very serious in many localities. Anything that the coal user can do to relieve this situation even slightly is a duty to the community as well as to himself.

One very obvious but often neglected responsibility of this sort is the prompt loading and unloading of cars. Not alone coal cars but cars of all types must be moved as expeditiously as possible if the railway systems of the country are to function even fairly well this winter. It behooves the chemical industries which are large users of freight cars to make adequate preparation for their part in this work. When a car is placed for loading, it should be filled at once and billed by the most direct route to destination. When a loaded car arrives at a siding, it must be unloaded immediately. No excuses should be permitted to interfere with this part of rail traffic handling.

The difference between immediate and only "fair" handling of this situation may make the difference between adequate and inadequate fuel supply. The price which one may pay in current inconvenience or bonus for overtime in order to accomplish these results will be a splendid investment. It will pay to get ready now and not wait until bad weather or traffic congestion makes the problem even more serious than it already is.

From One High Position to Another

IT IS WITH mingled feelings of pleasure and regret that we receive the announcement that Dr. S. W. STRATTON is to leave the Bureau of Standards to assume the presidency of Massachusetts Institute of Technology. The change will represent a great loss for the bureau. That institution will for many years stand as a monument to the vision and constructive ability of the man who has been its chief from the beginning until now when, twenty-one years old, it stands a mature evidence of well-nurtured growth.

Nor is there doubt that M.I.T. should receive our congratulations. It is an institution in which any man may find large opportunity for service and for constructive effort and hence to Dr. STRATTON also go our congratulations on the opportunity in this new field which that institution will afford.

May his work there prove as successful as has his public service in the Bureau of Standards. One could scarcely wish him greater success than that.

Any Size Is Standard

INQUIRY was made at the booth of one of the exhibitors at the recent Chemical Exposition for a catalog of stock sizes and shapes. The answer to the query was that any size or shape desired is gladly made for customers and that no standard sizes of the material were listed or carried in stock. This represents for the particular industry rather an unfortunate situation, and yet one all too common at present in many lines of business.

In this particular case, each new size or shape requires new dies or new tools. Yet the company stands ready to deliver any size as standard. It would be interesting to know how much this really costs the purchasers of the material, for certainly it would be vastly more economical if a reasonable number of standards were maintained and effort made to limit purchasers to these as far as their needs really could be served thereby. The saving might be a substantial sum in dollars per year and probably an appreciable percentage of the cost of any shipment of special sizes.

In a vast majority of cases there is considerable latitude in choice of sizes for such materials as the one in question. A designer is perfectly willing to vary a few hundredths of an inch, and if given adequate data will find it quite as convenient to design his equipment to use the sizes which the maker carries regularly in stock as a standard. It is surprising in this modern day of efficient management to find that a prominent concern apparently ignores the advantages of simplification in production. Doubtless there are many others. All should stop and consider the folly of the policy.

Readers' Views and Comments

Black Fractures in Carbon Tool Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—We have recently had opportunity of examining a small piece of steel, sent us by Mr. Green and described by him in your columns for Aug. 9 (p. 265). Some comments written primarily from the standpoint of men working with malleable cast iron may be of value.

Under the microscope the graphite in the piece sent us is present in thin flakes and not nearly as much spheroidized as is the temper carbon of malleable casting. I have never in the past seen such a flaky condition in any graphite which was precipitated below about 1,050 or 1,100 deg. C. There is here some suggestion that the observed graphite came out early in the history of the specimen, yet the fact that the graphite does not exist in the surrounding ring is scarcely consistent with the precipitation of graphite in the ingot before rolling. May we suppose that the ingot was graphitic and that the pressure exerted by the rolls assisted the recombination of graphite, due to the contraction in volume assaociated with the formation of cementite, as suggested by Heike? If this assumption is not tenable, then it would seem that the only possible explanation is that such stresses are set up in the surface layers during rolling which have prevented graphitization during the anealing period. There is here another anomaly.

It is well known that even in the high-silicon, high-carbon alloys of the malleable cast iron industry graphitization is a matter of many hours. The times may run from 40 to 80 hours above 1,500 deg. F., followed by at least an equal time in cooling. How graphite should form in but slightly hypereutectoid steels in a time as short as is involved in the annealing of tool steels has always been a mystery to me. I have frequently heard the experience mentioned, but Mr. Green's sample is the first which I have personally seen.

H. A. SCHWARTZ,
Manager of Research,
The National Malleable Castings Co.

Cleveland, Ohio.

The Record of Science

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have just read with considerable interest and enthusiasm the address of William Warner Bishop before the Michigan Chapter of Sigma Xi on "The Record of Science." There is one very significant statement in this address: "Bibliography is the foundation of research." Mr. Bishop gives a very clear brief for his premise, and the case could not be argued by a single man better equipped to argue the case.

Mr. Bishop further shows that we are placing too much stress on the laboratory side of research and not enough on the fact side.

Facts support Mr. Bishop in his assertion. In the second edition of the National Research Council's "Research Laboratories in Industrial Establishments of the United States" we find over 526 organizations supporting research laboratories. In *Science* for Jan. 13, 1922, on page 51 we find that there is invested in this country alone 565 funds for research, yielding annually over $22,000,000. Yet I venture to assert that not 50 per cent of these same institutions provide adequate funds, if any at all, for a good foundation in research—namely, what I choose to call "laboratories for research fact-oring"; to put it in Mr. Bishop's phraseology, laboratories in the "book sciences." To illustrate the relative importance given to the laboratory for ordinary research and the laboratory for fact research, or library, I know of one industrial firm that invested over $400,000 for research laboratories, and yet the sum invested in book equipment was less than one-tenth of that amount.

Why not establish endowments for laboratories in research fact-oring and fellowships in the "book sciences?" The need is here and should be met.

Pittsburgh, Pa. K. WALKER.

A New Vessel for the Absorption of Hydrochloric Acid

To the Editor of Chemical & Metallurgical Engineering

SIR:—I note in "Readers' Views and Comments" in your Aug. 23 issue M. A. Laury of Rockville Center, L. I., has misunderstood a statement in my article which appeared in your Aug. 2 issue, and I am writing you to clear up this point in case other readers have given it the same interpretation.

My statement to the effect that it was only possible to produce acids of low strength from towers was intended to convey the idea that only low-strength acid can be produced if the absorbent is permitted to flow through the tower absorption system by gravity only and is not recirculated and applies more especially to the gases of higher strength than those of lower strength.

The point which I intended to bring out was that in order to obtain acids of higher strength by single exposure of the absorbent to the gases it is necessary to use absorption equipment which will permit rapid removal of the heat generated and that the construction of a tower to accomplish this is not, in general, practicable.

Acid of much higher strength than 20 deg. Bé. has been obtained from towers, but only by cooling the acid produced in the tower and recirculating this through the tower repeatedly until the strength is increased to the desired point. STEPHEN L. TYLER.

New York City.

Correction

In one of the "Sidelights on the Chemical Exposition" appearing in the Sept. 27 issue, the "Dow" tray thickener was mentioned as having been applied to the clarification of raw cane juice by the firm of "Petree & Dow." This of course should have been called the Dorr tray thickener and the firm is Petree & Dorr.

Mechanical Improvements vs. Fundamental Research in the Leather Industry

To the Editor of Chemical & Metallurgical Engineering

SIR:—In your issue of Aug. 30 (page 465) you publish an article from the versatile pen of John Arthur Wilson, entitled "Mechanical Improvements vs. Fundamental Research in the Leather Industry." The writer has made an exhaustive study of the mechanical end of the leather business and while he agrees thoroughly with Mr. Wilson that opportunities for increased production efficiency lie less in mechanical improvements than in fundamental research, he feels bound to impress on the tanner that 6 months' tanning of sole leather is not only an unnecessary waste of time and money invested, but almost a commercial crime for which all users of leather have to pay.

The fundamental chemical research under Professor Thomas of Columbia and that of Mr. Wilson have been of inestimable value to the tanning industry, and they have gone far toward a campaign of industry to show the tanner what the possibilities—yes, certainties—of chemistry can accomplish, yet I feel sure that neither of these accomplished men would agree with me that sole leather can be tanned in 5 or 6 days with but one handling, producing fine, light-colored, plump, smooth grain leather of great toughness. The apparatus that produces this result is very simple of construction and "foolproof" in operation.

I am not writing this to draw attention to my patents or to describe in detail the apparatus that is in daily operation at our laboratories, but simply to give my views as to why the tanners do not abandon the antiquated and senseless method of tanning they now pursue.

It has been my experience that tanners, as a rule, are too slow and even unwilling to adopt what seems to them a revolutionary process of tannage, but it must be known that the two largest producers of sole leather are now tanning a part of their product in less than a week's time and are fast approaching complete installation of rapid tanning machines.

I want to assure Mr. Wilson that while it is true that the rate of tanning, the rate of penetration of tan liquor into a hide, the degree of plumpness of the leather and its color and smoothness are all controllable chemically, it is just as true, and more understandable, when leather is tanned in a machine where every individual side gets the same treatment in 5 or 6 days.

The great drawback to the English Wilson machine lies in the fact that the sides, as they come from the drenches, are in a very tender state and will not withstand constant falling and folding as they revolve in the machine, as such flexing produces tan wrinkles and raised grain. Sole leather, to be properly tanned and plumped, should have practically no movement that will bend or wrinkle the hides.

The writer spent two long years in developing apparatus that would automatically tan 144 sides in a machine having 1 minute periods of immersion and emersion, permitting the hides to slip gently into the tanning liquor and to float through the same in a natural position, emerging from the liquor without sharp bending or unfolding. As before stated, we are able to get the best results in 5 and 6 days.

While the industry needs the most highly trained chemists available, it also needs men who will accept facts as against theory, and who will awake to the fact that "layaways" should be obsolete and that a vast amount of money can be saved to the industry if tanners will develop a spirit of investigation and acquaint themselves with development that may be theirs for the asking.

MATTHEW M. MERRITT.

Salem, Mass.

The Chemical Industry and Its Exposition

To the Editor of Chemical & Metallurgical Engineering

SIR:—It is reassuring to find in *Chemical & Metallurgical Engineering* the admission that criticism—adverse criticism—of the Chemical Exposition as now conducted does exist and is finding expression in several quarters. As noted in your editorial, this criticism has been diverse and confusing; but out of all the clamor and discussion one point stands out clearly—namely, that the management needs closer contact with the exhibitors.

It is admitted quite generally that the producers of our chemicals, chemical equipment and raw materials, as well as the chemists, engineers, plant managers and salesmen, were not in sufficiently close touch with the management to make an entire success of this national exposition.

Hence has arisen the need for a new enterprise, a Chemical Industries Exposition managed by the industries themselves, such as is now proposed. By its name, the Chemical Industries Exposition, the new organization is pledged to serve the interests of chemistry. It promises to show what industries chemistry has built up and how chemistry works in those industries.

Our first chemical show was a brave attempt to fulfill such a promise. The time was propitious and the show was considered a success, while the expositions that succeeded the initial show were also considered successes; but now that the novelty has worn off and we can scrutinize conditions more closely we find that a true exposition of our chemical industries has never been held, what we have had being only a heterogeneous mixture with an overwhelming number of exhibits that would fit in a machinery show or a show by any other name as well as in a chemical show.

A true exposition of our chemical industries is as necessary today as it was in 1915. To borrow the language of the salesman, it is the ideal way of "selling" the chemical industries to the country at large. It should be the ideal way of demonstrating that in our chemical industries lies the possibility of our greatest industrial development.

This is what is proposed by the new Chemical Industries Exposition, which will be a purely co-operative organization for the advancement of our American chemical industry. An exposition under the management of professional showmen such as we have had in recent years cannot be considered representative, neither can it be arranged as an exclusive, orderly and well-balanced exposition of the chemical industries as was originally intended and as is now proposed.

In view of the foregoing it is hoped that *Chemical & Metallurgical Engineering* will yet see its way clear to support the new enterprise.

ADRIAAN NAGELVOORT.

New York City.

To Study Fuel Economy in District of Columbia

At the request of the director of the budget, the Bureau of Mines is conducting a fuel economy survey to investigate the conditions under which fuel is used in the various government fuel-using plants in the District of Columbia, and to determine what economies, if any, can be made in the use of such fuel.

European Conditions as I Saw Them

Epitome of Six Months' Study in Germany, Belgium, France, Switzerland and Italy—Failure of Germany's Economic War the Fundamental Cause of Present Financial Collapse and Its Effect on Other Nations

By J. S. Negru

Editor's Note: Mr. Negru, managing editor of *Chem. & Met.*, has just returned from a 6 months' trip to Europe, where he studied the industrial, technical and economic conditions in the principal countries of the Continent. This article is the first of a series that will portray intimately the results of his interviews with financial, political and industrial leaders. Other articles will deal with detailed observations on which this summary is based.

A SIX months' trip through Belgium, France, Italy, Switzerland and Germany for the purpose of getting first-hand information and impressions on the technical and economic status of those countries may seem at first sight a simple and agreeable undertaking. As a matter of fact, it proved to be a very trying task when it came to the actual performance. Although many circumstances and conditions were anticipated and taken into consideration well in advance, many more unforeseen circumstances were encountered during the trip which sometimes made it necessary to alter quite radically the plans laid down while still in New York City.

Plans of Trip as Outlined and as Carried Out

It was quite easy to outline a plan covering places to visit, persons to see and subjects to study. In fact, this was done to a nicety. The places to visit were those generally regarded as the leading industrial regions of the above-mentioned countries. The persons to see were obviously the leaders in the industries, the presidents and secretaries of the leading technical societies, the editors of the well-known technical papers for the different industries covered by the thirteen McGraw-Hill engineering and industrial papers, with special attention to those covered by *Chemical & Metallurgical Engineering*. Incidentally, there were other important sources of information—economists, labor leaders and just plain folks. The subjects to be studied were mainly the actual technical progress during the last few years, scientific research, the economic conditions as to production, and relations between employer and employee. Incidentally, I was to get some ideas on everyday working conditions with respect to machinery, apparatus and processes in European plants compared with those in the United States.

A schedule covering this broad program was carefully made out, advance information was sent abroad regarding my contemplated trip and its purpose and the anticipated trend of events and interviews were sketched out as fully as possible. With plans thus matured and with a deep feeling of the importance of the trip to the readers and advertisers of *Chem. & Met.* and other McGraw-Hill publications I embarked on the good ship Finland sailing from New York Feb. 11 and arrived in Antwerp Feb. 22.

In the interim of the past 6 months I have visited the places scheduled and many more; I have interviewed the persons originally selected and many more of equal importance. But unforeseen conditions arose when it came to the subjects to be studied. The economic status of the countries visited was so abnormal and so differently interpreted by interested parties that I was led to dwell far more in detail on this part of the program than on anything else.

My first intention was to edit my notes in chronological sequence, but the present upheaval in all the industrial countries of Europe, particularly in Germany, leads me to believe that it were more timely first to outline what I regard as the very fundamental cause of the breakdown in Germany, with the result that all of the other countries are feeling acutely the repercussion of such an unhealthy economic condition.

Obedient Germans

The German possesses as a general rule a highly developed obedient mind, and few are those who, being sufficiently emancipated, dare assert their individuality. The German Government created during the so-called revolution shortly before the armistice is a sort of emergency organization like the receiver of a bankrupt business concern, with a beautifully written constitution as a guide, but with no self-asserting leaders, and hence extremely weak.

To this very day practically the entire German people are still lulled with the belief that Germany, more than any other belligerent country in the World War, acted as a civilized nation, and do not yet know the extent of the wanton destruction engineered by their military and industrial leaders in the occupied French, Belgian and other allied countries. The Germans, as I have learned to see them, consider themselves persecuted for no reason whatever. They were not given to understand that they must make good, partly at least, what they call incidental war destruction. They were fed from the beginning, and still are fed, with an abnormal hate toward France, and more recently with an even more abnormal so-called friendship toward England. Thus they have been led to the point where they typify to the very letter the cartoon "Vox Populi" printed in the June 2, 1922, issue of *Fliegende Blätter*, which is here reproduced.

The German Economic War

With a weak government on one side and a meek people on the other, it will be seen how very easy it was for wolves in sheep's clothing to bring about what really happened—namely, to involve Germany in a disastrous war before, so to speak, the ink was yet dry on the signature of the Versailles treaty.

Many are the interpretations of the causes leading to the present pitiful condition in Germany, but all of them seem to be attempts to place the blame on the other fellow and not in the least on the Germans themselves. The Versailles treaty stipulations are being represented as demanding far more than Germany can fulfill. All such interpretations by bankers and others are, to my judgment, dictated strictly by egoistic business considerations. But when analyzed in the light of many conversations I had with leading German intellectuals and plain people in many German districts, the break-

From *Fliegende Blatter*, June 2, 1922.

VOX POPULI

down seems to be a normal consequence of losing the economic war which she has been waging against all the world for nearly the past 3 years.

Briefly stated, the specific plan of this economic war was to flood all foreign countries with German finished products, especially those requiring a large amount of manual labor, at prices far below their intrinsic value. It was to be a super-dumping policy in the expectation of spreading unemployment in other industrial countries, thus creating an atmosphere and undercurrent of opposition to the Versailles treaty, and offering as a condition of truce the cancellation of that treaty and a status quo ante bellum 1914.

Such an economic war was conceived by a few Germans of the Stinnes type as the best means of evading the fulfillment of the conditions of the peace treaty. This was not because Germany could not fulfill them, but because primarily the German honor must be saved. And the worst that could happen to tarnish the good name of Germany, according to their peculiar psychology, would be to submit to the treaty stipulations. They were not able to bring themselves to act as good losers.

Failure of Germany in Its Economic War

When the German soldiers returned to their homes after the war, they were treated as unconquered *Helden* and still are considered as such. They found their houses, fields and factories open, in full prosperity and ready to engage them in productive work. It is well known that the Germans are very industrious. Before 1914 the intrinsic value of domestic production in Germany was many thousands of millions of gold marks per annum. The more so could have this been the case after the war if the new government and the masses had not been led astray by the then few powerful Germans who thought to evade the stipulations of the Versailles treaty by means of an economic war. How very simple such a war looked to them is proved by the readiness with which it was approved and carried on. That it was hastily conceived and badly fought is proved by the dire distress now confronting the German Government and the German people in a Germany which is still eminently rich.

The German mark, which in 1918 was worth 25 cents, has recently been quoted at a little less than 0.05 cent, and everything points to its further decline. And yet Germany is working at full capacity in all her industrial lines, the German people are among the most industrious in the world and German agriculture is sufficient to supply at least 70 per cent of the people's food requirements.

As in their conceited war policy of imposing peace negotiations by methods of frightfulness, so in the present economic war they hoped to reach their goal without counting on the psychology of the other nations. They expected that the foreign buyers of their products, who would purchase them at far below their intrinsic value, would content themselves with, say, a maximum of 100 per cent profit. But they did not count on the rapacity of the newly arisen middlemen who, not content with such profit, succeeded in placing in foreign countries the cheaply bought German wares at prices a trifle below those of similar domestic products. This fulfilled only part of the German aim—namely, the spreading of temporary unemployment. But it was done at the cost of breaking down the German fighting power by bringing the government near to the point of fraudulent bankruptcy, and this in spite of the fact that the tonnage of products exported and their true intrinsic value are so very high. Neither the total amount of gold marks

which Germany has paid to the Allies up to date nor the status of the Saar district and Upper Silesia warrants the bankruptcy of a country which only about 4 years ago regarded itself as the very leader among the world's nations and rattled the saber in an attempt to make everybody else admit it.

Germany Can Regain Her Place in the Community of Nations

The gradual losing of their economic war and not the hair-splitting notes to and from the Allies and the various conferences is the cause of the German breakdown. Fortunately this could be easily mended if only the German people could be brought to realize that just as in 1918 their armies did not return to their homes as unconquered *Helden*, so now their economic war is lost forever. Honest work with honest competition, coupled with a sincere resolution gradually to fulfill Germany's signed promises at Versailles, must be henceforth their guiding policy if they are to regain their new place in the community of nations.

The next of this series of articles will be published in the issue of Oct. 25, 1922.

Electrosmosis and Electrophoresis, Two Definitions*

By Oliver C. Ralston
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THE purpose of this note is to call attention to an exasperating confusion of terms in the literature that deals with electro-capillary phenomena, the electric double layer at phase boundaries and in colloid chemistry. The four following words should cover all general cases where an electric current is passed through a fluid medium, with or without a diaphragm, with or without the presence of other solid, liquid, or gaseous particles other than the electrodes or on the electrodes:

Electrolysis.	Electrophoresis.
Electrosmosis.	Electrostenolysis.

Nearly all the roots used in these words are of Greek origin. Electrolysis, for instance, is divided into electro and lysis from roots meaning "by means of electricity" and "loosening, dissolution or destruction" respectively. It is therefore well to consider first the meanings of portions of a few words.

Cath-	down or away.	Endos-	within.
-ode	way or path.	-mosis	push or impulse.
An-	up or toward.	Cata-	down or away.
-ode	way or path.	-phoresis	bearing or carrying.
Os-	mouth or pore (Latin).	-sis	suffix meaning process or state.
-mosis	push or impulse.	-osis	suffix meaning process or state.

With these few roots and their meanings it is now possible to discuss the above four words, which are proposed in the interest of obtaining uniform nomenclature, with a minimum of change from present practice and without inventing completely new words.

Object of Words Proposed

Electrolysis is a term universally accepted as meaning the act or process of chemical decomposition by means of the electric current.

Electrosmosis is proposed by the writer to supplant such terms as electric osmose, electrical endosmose, electric endosmosis, electro-osmosis, etc. All of these terms mean the passage of liquids through diaphragms (osmosis), due to the application of electrical forces. They are all in use, but all are somewhat awkward when used otherwise than as nouns. If the noun "electrosmosis" is adopted, it can be modified to the verb "electrosmoze" to correspond to the verb "electrolyze."

Electrophoresis is proposed to supplant a number of words that have been sadly misapplied but whose use has almost become correct through common (mis)usage. By electrophoresis is meant the travel, transport or "wandering" of a particle of solid, liquid or gaseous matter suspended in a mobile medium, liquid or gaseous, when a unidirectional electric stress is applied. At the present time "cataphoresis" is the word usually heard in this connotation, although "electrophoresis" has been used by a few discriminating writers.

The objection to the use of the word "cataphoresis" is that most of the particles suspended in aqueous solutions are negatively charged and migrate toward the anode, whereas the prefix "cata" or "cath" is already associated with "cathode" and "catholyte." A few writers have therefore tried to apply "cataphoresis" only in cases where particles wander toward the cathode, and have invented "anaphoresis" to apply to the usual case of wandering toward the anode. They were the ones who invented "electrophoresis" as the general phenomenon. Due to the wide use of "cataphoresis" it would seem unwise to try to force its use for a case of "electrophoresis" in which the particle wanders toward the cathode, a direction which is just the opposite of 90 per cent of the cases of so-called cataphoresis. Rather it seems wiser to adopt a term somewhat different in spelling, enough different to force recognition of the true meaning, and yet not enough different to need definition. Therefore:

Cathodophoresis is proposed to mean migration of suspended particles toward the cathode when under the influence of a unidirectional current.

Anodophoresis is proposed to mean migration to the anode.

Usefulness of the Term "Electrophoresis"

A further discussion of the possibilities of the use of the term "electrophoresis," as defined above, will show its great usefulness. It need not apply alone to colloidal solutions, but it can also apply to smokes, mists and fumes. The Cottrell electrical precipitation process has long lacked a single word to describe correctly its prenomena. It is permissible to speak of "electrophorizing" these suspensions of solid or liquid particles in gases. We can also "electrophorize" emulsions of water in crude petroleum, a process which has long wanted a name and is now in such large-scale use that a less accurate name is likely to be attached to it if we do not act to embody properly these ideas in suitable words.

Electrostenolysis is a term used to designate the deposition of certain metals in small capillary pores of certain diaphragms when solutions of these metals are electrolyzed. This is a rather obscure phenomenon, but its name is fortunately quite correctly derived and used. However, the definition should not be restricted to the deposition of metals in pores of diaphragms, as someone may discover methods of depositing other elements or groups in like manner.

*Paper presented at the forty-second general meeting of the American Electrochemical Society in Montreal, Sept. 21, 22 and 23, 1922.

Handling the Finished Products of Industry—VI

The Handling Problem in Sugar Manufacture Consists of Packing and Shipping a Single Finished Product in Many Ways—Solution of This Problem Illustrated by the Layout of the Baltimore Refinery of the American Sugar Refining Company*

By Graham L. Montgomery

ONE of the most difficult problems met with in handling finished products is that condition where a large bulk of product is to be packed in many packages and shipped in several ways. This type of problem is one encountered particularly in the sugar refinery.

Because of this difficulty, many plants of this type have never attempted the installation of a real handling system. Others have placed as much handling equipment as could well be worked in with their existing layouts, but have not been able to make their system a unified whole. This particular industry has been one where it has been necessary to wait for the construction of a real up-to-date plant in order to find the possibilities which lay in handling the finished sugar completely by automatic equipment.

Keeping these two facts of diversity of package and diversity of shipping-means in mind, together with the additional fact of large total output, let us consider the new refinery at Baltimore recently placed in operation by the American Sugar Refining Company. This plant is the most modern in the country. In designing it, the American Sugar Refining Company pooled the best of its knowledge and experience—forming a consulting board, made up of expert sugar men, refinery operating engineers, construction engineers and others, which worked out for the Baltimore plant a comprehensive handling method, one which provides ample opportunity for expansion when that becomes necessary.

The product is placed in every conceivable type of wholesale and retail package, and is shipped by all available means over a wide territory.

Where the Finished Product Handling Occurs

For the purpose of the study of the handling system used here, a good starting point can be made at the place where the granulated sugar leaves the screens which separate the coarse sugar and the dust from the commercial grade. There is, in the case of powdered sugar, one further manufacturing process—that where the granulated sugar goes through pulverizing mills. With this exception, all operations beyond the screen consist of handling and packing operations. These operations do not increase production or add to the quality of the product, but they are necessitated by the exigencies of marketing and involve what we classed as non-productive labor in the first article of this series.

This would hold for any sugar refinery. The Baltimore refinery here described illustrates the nearest approach to perfection that has been obtained in this work, the nearest approach to elimination of non-productive labor that seems at the present time possible; and the rendering of as many operations as can be automatic.

As a basis of study of the handling system, the following tabulation is given for methods of packing and types of shipping:

Packing

1. Granulated sugar packed in bulk barrels.
2. Granulated sugar packed in bulk sacks.
3. Powdered sugar packed in bulk barrels.
4. Granulated sugar packed in cotton bags.
5. Granulated sugar packed in paper cartons.
6. Powder sugar packed in paper cartons.

Shipping

1. Local shipment by gasoline or electric trucks.
2. Water shipments on lighters to ships or to piers.
3. Railroad shipment in box cars.

General Handling Considerations

From the screens, the desired grade of sugar may take two paths. Immediately below the screens are large maple-lined concrete bins to which the sugar may be fed directly by spout. These bins serve to supply the sugar for filling bulk barrels and sacks, the filling of these containers taking place immediately under the bins. They also serve as a storage reservoir to take sugar from the manufacturing department when the packing department is not working, and to keep the packing department supplied should the manufacturing department shut down for any reason.

When these bins are filled with sufficient sugar for loading the bulk barrels and sacks, the sugar is led from the screen by spouts on to a trough belt conveyor. This conveyor discharges into a vertical spout, which delivers the sugar in one of two ways. First, to the conveyor which supplies the packing department for paper cartons and cotton sacks, and second, to the conveyor system which feeds the powdered sugar department.

Packing Bulk Sugar in Barrels

Before describing the methods used for filling barrels with bulk sugar, it is of interest to consider how the barrels are handled from the cooperage.

The cooperage is housed in a building 465 feet away from the point where the barrels are to be filled. In this cooperage the lumber from which the barrels are constructed is received from the company's own lumber mills in cars and made up into the barrels—the heads being made separately and delivered to the packing department in the same quantity as the barrels.

It is interesting to note in passing that the American Sugar Refining Company owns its own forests; does its own lumbering, has stave and lumber mills, owns various railroads, due to this lumber work, which are even equipped in some cases to carry passengers—in fact, owns many similar adjuncts which make it practically independent of others for the necessary accessories, such as cartons and barrels.

The conveyor which carries the barrels from the cooperage to the packing building is particularly worthy of note. It is made up of two chains running parallel, just as in the ordinary slat conveyor; but, in place of

*Previous articles in this series have appeared in *Chem. & Met.* as follows: Article I, vol. 26, No. 18, p. 823, May 3, 1922; Article II, vol. 26, No. 19, p. 885, May 10, 1922; Article III, vol. 26, No. 24, p. 1,114, June 14, 1922; Article IV, vol. 27, No. 5, p. 199, Aug. 2, 1922; Article V, vol. 27, No. 15, p. 731, Oct. 11, 1922.

slats, ball-bearing rollers are used. The barrels ride forward on these rollers just as they would on a slat conveyor. But if the conveyor load is stopped for any reason, the conveyor continues on underneath the load without any particular amount of friction because of the ball-bearing rollers.

This type of conveyor is particularly adapted to just such operations as filling or packing. It permits the production of barrels to go on at the cooperage regardless of the rate at which the barrels are filled, the long conveyor acting as a storage if filling is held up for any reason. There are many other cases where the operation at the loading end of the conveyor must run at a different speed from the operations at the discharge end. For this type of service, the conveyor described above, which is called a driven-roller conveyor, is in many cases ideal.

Handling Empty Barrels in the Packing Building

This straight run of conveyor from the cooperage enters the floor of the packing building on which barrels are packed at a point near the ceiling, and delivers through a gravity roller spiral to a second driven-roller conveyor, which runs the length of the barrel-loading dock and at the same level. By means of this conveying arrangement, a constant supply of empty barrels is kept handy at the loading dock. Reference to Fig. 1 shows the approximate arrangement of this system.

The workers who are doing the barrel filling take the barrels as needed fromthe last conveyor and after lining with paper place them on shakers under the filling spouts which lead from the large concrete bin previously mentioned. These shakers, by keeping the barrel agitated while it is being filled, insure its full loading.

Handling Filled Barrels

After the barrel is filled, it is rolled off of the shaker on the opposite side from the empty barrel conveyor and the head is placed in position. On this side of the barrel loading dock is another driven-roller conveyor similar to the others described. This conveys the filled barrels to the scale, where their weight is noted. So that the scale operator may have absolute control of the rate at which barrels pass over his scale, a pneumatic device has been installed at the end of the driven-roller conveyor, which causes the barrels to pile up here until wanted. By means of this penumatic device,

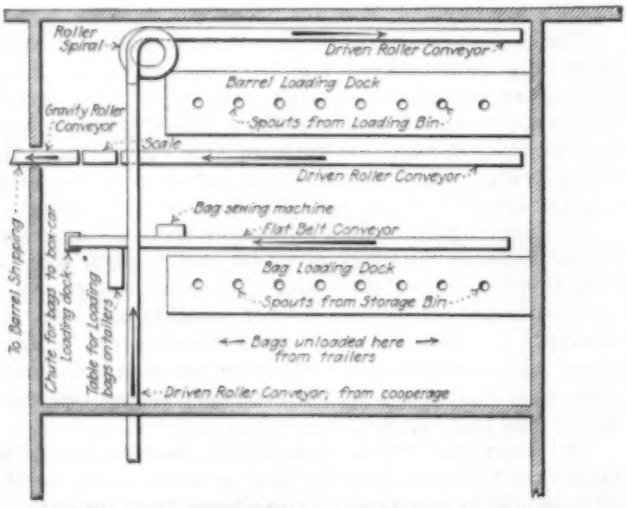


FIG. 1—DIAGRAMMATIC LAYOUT FOR BULK PACKING DEPARTMENT

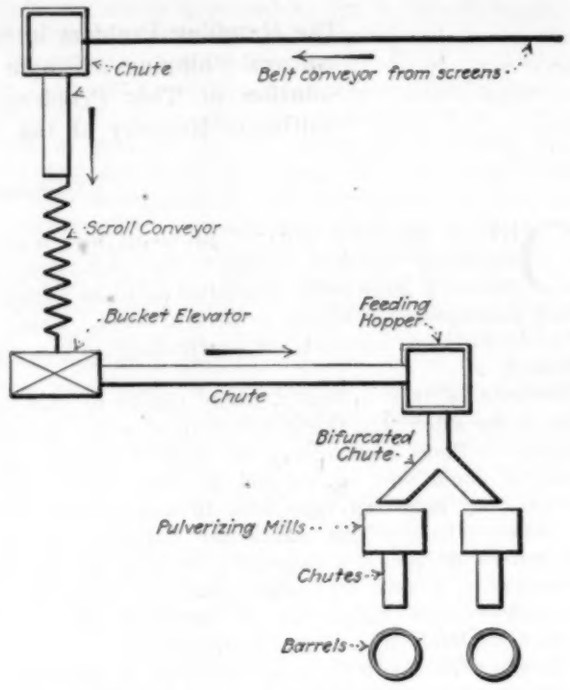


FIG. 2—DIAGRAMMATIC LAYOUT OF POWDERED SUGAR DEPARTMENT

he can release them one at a time onto the gravity conveyor which carries them over the scale. After their weight is noted, the barrels continue on this gravity roller conveyor, which discharges them on a loading dock, where they may be either loaded onto trailers or onto the barrel elevator and distributed as described under the heading of shipping.

Loading Bulk Sugar in Bags

Fig. 1 also shows the layout of the loading system for bags of bulk sugar. The routine is as follows: The empty bags are brought to the bag-loading dock on trailers. The workers place them as needed under spouts coming from the large concrete storage bins. Each of these spouts is provided with a weighing hopper, so that each sack receives a definitely weighed amount of sugar. After filling the sacks are placed on the conveyor shown in Fig. 1 running alongside of the bag-loading dock. This conveyor is a flat belt running on a bed of closely spaced ball-bearing rollers which insure a smooth-riding, flat surface for the bags to ride on. A rail has been placed along the far side of the conveyor against which the bags lean, so that they will not tip over. In this way, the bags are conveyed to the sewing machine, where they are closed; and they are then disposed of in one of two ways. First, for placing on trailers, they are deflected from the belt onto a loading table by a plow. From this loading table, they are placed on trailers as desired. Second, for box-car shipment, they discharge over the end of the bulk conveyor into a chute which conducts them to a point near the railroad shipping dock. The further disposition of these bags will be taken up under the subject of shipping.

Packing Powdered Sugar in Bulk

Reference to Fig. 2 will give the reader an outline of the conveying system used in handling powdered sugar. The bulk conveyor which receives the granulated sugar from the screen discharges into a straight

chute. Part way down this chute there is a deflector which, when in operation, delivers sugar to a branch chute. This chute delivers the sugar into a scroll or open-screw type conveyor. This latter feeds a small bucket elevator, which raises the sugar to a bin at the ceiling of the floor above. This bin in turn feeds the pulverizer mills, which discharge into a hopper, from which the powdered sugar may be loaded into barrels as desired. This hopper is also arranged to feed the automatic packing machinery, by which powdered sugar is placed in cartons.

As the demand for this particular kind of sugar in this particular package—that is, bulk barrels—is not great, there has been no necessity for installing an elaborate fixed handling system here. Instead, the empty barrels are brought to the proper position on trailers filled and then taken to the shipping or storing point on the same trailers.

Delivering Sugar to the Automatic Package Equipment

Mention has been made above of the conveyor which supplies the package department. When the granulated sugar storage bins are filled, this conveyor is fed directly from the screens—that is, if the manufacturing department is producing sugar at that time; on other occasions this conveyor may be fed by spout from the storage bins. These spouts are provided with hand-operated slide gates, and in this way can only be opened by the personal attention of the operator, so that there is little possibility of causing sugar to be fed to the conveyor when it is not desired to do so.

When sugar is fed to this conveyor directly from the screen, it is delivered from the belt conveyor under the screen to the vertical chute mentioned above. Both this vertical chute and the spouts from the bin deliver to the conveyor in the same manner. This is through an automatic loading hopper which is operated by the motion of the conveyor and which delivers to each bucket of the conveyor a certain definite amount of sugar—such an amount that the conveyor is carrying at its most efficient rate, each bucket being filled with the maximum which it will hold without any spillage.

Special Buckets Used for Sugar Handling

The conveyor used here is a pivoted bucket carrier of the type ordinarily used in power plant work for handling coal. There is one innovation here, however. The buckets are all aluminum, as is every other part of the conveyor which might come in contact with the sugar. This prevents any discoloration of the sugar by contact with iron.

The system of handling here used is shown in outline on Fig. 3. The pivoted bucket carrier may be discharged at either of two points. These discharges deliver the sugar to scroll conveyors, provided in the bottom of their casings with a series of rack-and-pinion operated gates. Under each of these scroll conveyors is a large maple-lined concrete storage bin. One of these feeds the automatic packing machinery which packs the sugar in paper cartons, while the other feeds the machinery which fills cotton bags.

Packing Sugar in Cotton Bags

There are various sizes of cotton bags such as 2 lb., 5 lb. and so on, into which sugar must be packed for the purpose of the retail trade. On the floor below the bin mentioned above, then, are located a series of

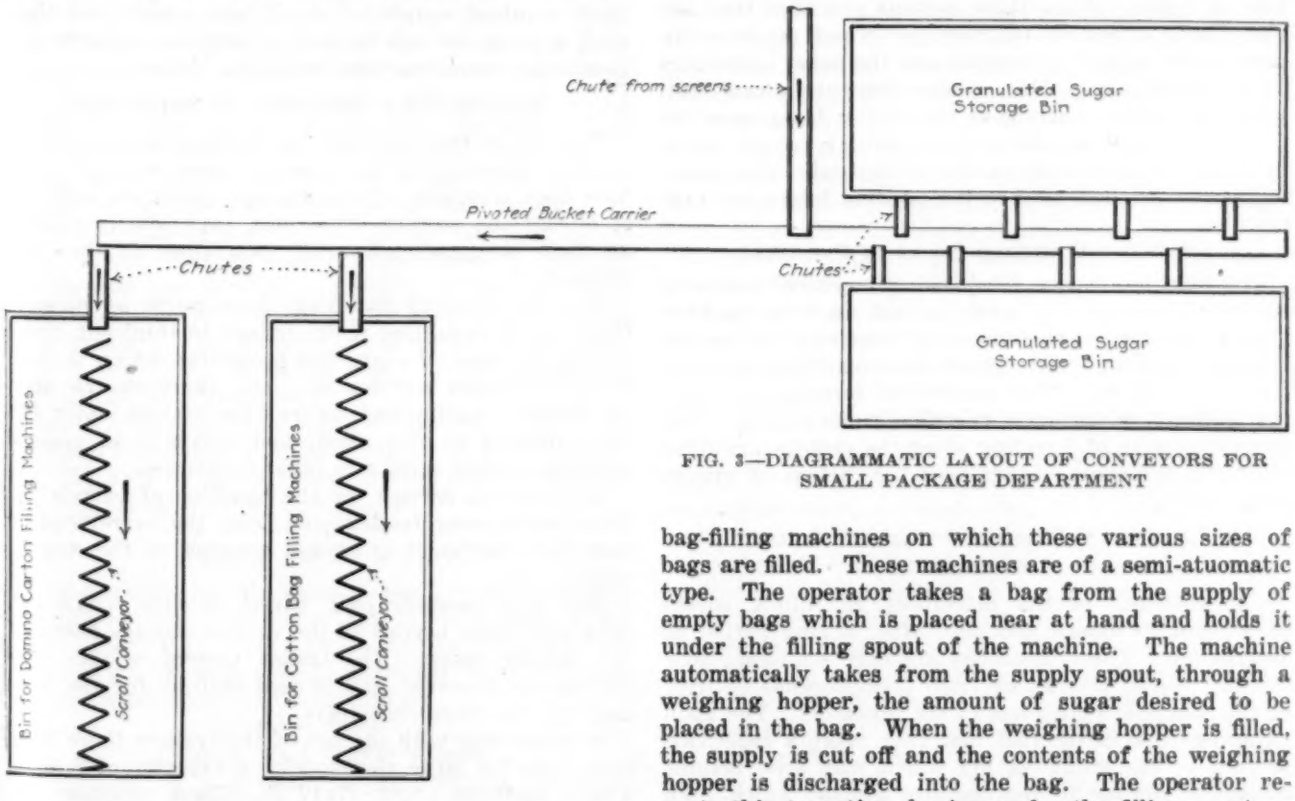


FIG. 3—DIAGRAMMATIC LAYOUT OF CONVEYORS FOR SMALL PACKAGE DEPARTMENT

bag-filling machines on which these various sizes of bags are filled. These machines are of a semi-atuomatic type. The operator takes a bag from the supply of empty bags which is placed near at hand and holds it under the filling spout of the machine. The machine automatically takes from the supply spout, through a weighing hopper, the amount of sugar desired to be placed in the bag. When the weighing hopper is filled, the supply is cut off and the contents of the weighing hopper is discharged into the bag. The operator repeats this operation, having under the filling spout an empty bag to receive each weighed discharge at the time of its occurrence.

The portion of the machine on which the bag rests under the filling spout is a rotating table, and after the bag is filled this carries it to a second operator. This operator is provided with a sewing machine, which is part of the filling machine, and with which the bag is closed. The rotating table then carries the finished

bag to a point where it is discharged and drops down a chute, for further disposition.

Automatic Filling of Paper Cartons

The machinery used for filling paper cartons with sugar is entirely automatic. In this machine, cartons are fed flat as shipped and the machine opens these cartons, finishes the bottom of them fast with glue and feeds them upright to the filling head. This filling head is in two parts, the cartons passing under it on a small rotary conveyor or carrousel. When the empty carton comes under the first filling spout, it is stopped by the mechanism and receives about nine-tenths of the load which it is to contain. The conveyor then carries it on under the second filling spout. The portion of the conveyor under this spout consists of an adjustable scale, which may be adjusted for various weights which the finished carton is to contain. The spout here is automatically connected with the scale and discharges a fine stream of sugar into the carton until the scale just balances, when the supply is shut off.

The carrousel then carries the filled carton beyond the spout and discharges it on to a straight conveyor which takes it through the sealing machine. In the sealing machine the top of the carton is folded down and pasted shut. An additional straight run of conveyor—flat belt type—takes the sealed carton to a packing table.

At these packing tables, operators stand who fill packing cases or large paper containers with the cartons of sugar. When these cartons are filled they are placed on a driven slatted conveyor, which conducts the cases under a nailing machine and the paper containers to a sealing department, where they are glued shut. From the nailing machine or the sealing department the filled containers are delivered to loading tables, where they may be loaded on trailers as desired. The empty containers are delivered to the packing tables by trailers also.

Packing Powdered Sugar in Cartons

The machinery used for packing powdered sugar in cartons is exactly the same as that used for packing granulated sugar in cartons except that when the carton is opened and the bottom glued shut an additional operation is introduced. This consists of forming and placing within the carton a paraffine paper lining. The general routine of handling after the cartons are filled is exactly the same as that used for cartons of granulated sugar.

Efficiency Developed in the Packing Department

The efficiency of the machinery for filling cotton bags could be determined only after a long period of observation. These machines are only semi-automatic and the rate of production from them depends entirely on the skill and willingness of the operators. The main advantage lies in the fact that they make a repetition job out of the filling—a job which may soon become automatic routine to the operator and at which high speed can easily be developed. It does not seem possible that anyone would question the increased efficiency of this filling method over a complete hand method.

The automatic equipment for filling cartons, on the other hand, presents a very definite picture of increased efficiency. The average production of these machines is twenty-eight filled cartons per minute.

The difficulties to be overcome in shipping material from this plant lie in the many points of origin of the various packages to be shipped and the fact that shipping must in no way be tied up to production, the production being free to go on without any reference to the amount of material which is shipped from the plant. For this reason all sugar shipped is placed in large sacks, in barrels or in good-sized wooden or paper containers.

This necessitates the further packing of the cotton bags in which granulated sugar is loaded. The chute which takes the cotton bags from the filling machine can deliver in two ways. One of these deliveries is made to a large sloping collecting table underneath the filling machine, and the other delivery is made to a similar collecting table a short distance away from the first one and parallel to it. At one of these collecting tables the sacks are loaded into barrels. Here the barrels are placed on shakers just as if they were to be loaded with bulk sugar and the sacks are thrown in and shaken down into a compact load. After a barrel is loaded the head is placed and the barrel is then taken to storage or shipping on a trailer.

The other collecting table is used for loading the cotton bags into burlap sacks. These sacks take 100 lb. as a complete load, and for convenience they are rested on scales during the time in which the sacks are placed in by hand. Along the side of this collecting table is a belt conveyor. This belt conveyor is exactly similar to that used at the point where bags are filled with bulk sugar and is operated in the same way, the bags being placed on it after they receive their required weight of small cotton bags and then, after passing through the sewing machine, are delivered to a table where they are loaded on trailers.

Storage With Reference to Shipment

Because of the fact that the production must go on without reference to the shipping, large storage spaces have been arranged. These storage spaces are sufficient to permit the storage of barrels, bags and containers as they are produced, until such time as they are shipped.

For this type of handling, from point of package origin to storage, and from storage to shipment, there is only one kind of conveying equipment which is thoroughly adaptable and flexible. This is the electric storage battery tractor and trailer—the system which has been adopted in this plant, and which is in general used for similar service in other industries.

As a special service for the handling of barrels the filled barrels may be delivered from the barrel-loading dock to a barrel elevator and elevated to the desired point.

This is a specially built barrel elevator which can raise and lower barrels to the various storage floors of the storage space. The trailer system is also used for barrels, however, and is used entirely for the bags and for the other containers.

In connection with the use of the trailers there have been installed large elevators of a capacity of 8 tons, with a platform about 17x17 ft. These elevators are provided with an automatic micrometer leveling device so that the operator stopping anywhere near the desired floor has to pay no further attention to his elevator, which automatically adjusts itself to the correct floor level. As the load is removed from the elevator or as the load is placed on it, this device serves to compensate for the change in loading and to keep the elevator in exact position.

The various loads are taken to the points of ship-

ment—that is the railroad car loading dock, the dock for loading trucks for local shipment, or the pier at which lighters are loaded—in every case by tractor and trailer.

The upper floors of the building, in which storage takes place, are not served generally by tractors, although this can be done if desired. The trailers are mounted on ball-bearing wheels and may be shoved easily by hand to their position on the floor or to the elevator as desired. When they are delivered by the elevator to the ground floor, they are picked up by the tractor and taken to the proper loading dock for shipment. In all cases the loading docks are as near as possible level with the carrier into which the load is to be placed, so that the trailers may be run directly into the car, lighter or truck. In this way all rehandling is eliminated and the only handling that occurs is when the container is placed on the trailer at its point of origin and when it is removed from the trailer to the proper place in the carrier in which shipment occurs.

Noteworthy Points of This Installation

The particular point worthy of note in this handling installation is the fact that it forms a unified whole. The sugar is delivered to the various packing operations, all from one central storage bin, to be carried through many diversified operations and into several forms of final shipping containers. The handling system used in connection with shipments is so arranged that all of these various containers may be handled in exactly the same way by a completely flexible system. It is readily seen that no matter how the plant may be extended the same method of packing can be duplicated, and the methods of handling to shipment would be exactly the same as at present, with the addition of possibly a few more tractors to the fleet now in use.

The large number of trailers necessitated by this system of storage and handling has been brought up many times as an objection to its use in other industries. This objection does not hold good in practice, because the use of this multiplicity of trailers absolutely eliminates any rehandling, and the non-productive labor entailed in shipping is cut to about one-third the amount which would be necessary if the usual two rehandlings were indulged in.

The writer wishes to acknowledge the courtesy of the American Sugar Refining Company in making available the date on its handling system, which solves so well a problem so often encountered.

Natural Indigo in Java

The classification of indigo in the Soerabaya market is dependent upon the percentage of indigo blue, which varies from 60 to 70 per cent. The production of indigo in Java has been rapidly declining, owing to inability to compete with synthetic indigo.

English Rail Specifications

According to a revision of the British Standard Specifications for bull head railway rails, issued in June, 1922, the chemical composition of the steel may be specified by the purchaser from the following classes (where range is not given, the figure is a maximum):

	Open-Hearth				Bessemer		
	Acid		Basic		Acid		Basic
	Ordinary	High-Carbon	Ordinary	High-Carbon	Ordinary	High-Carbon	Ordinary
C	0.45–0.55	0.50–0.60	0.45–0.60	0.55–0.65	0.40–0.50	0.45–0.55	0.40–0.50
Mn	0.90	0.80	0.90	0.80	0.70–1.00	0.90	0.70–1.00
Si	0.15	0.10–0.30	0.15	0.10–0.30	0.15	0.10–0.30	0.15
P	0.06	0.05	0.05	0.04	0.075	0.06	0.07
S	0.06	0.05	0.06	0.05	0.07	0.06	0.07

Carbon and phosphorus analyses must be made from each heat before rolling. Complete analyses must be made from every 100 tons of rails. Arsenic and copper must also be reported if desired. The rail to be analyzed is selected by the purchaser, and the drillings are taken from a ¾-in. hole driven longitudinally in the left center of the head.

One impact test (with a falling tup weighing 2,240 lb., which is described in detail) is made from every heat. A 5-ft. piece from the top rail may be selected by the purchaser, or the crop itself may be used if the maker consents. After two blows of specified height (5 to 7 ft.), the permanent set must not exceed 3.7 to 4.3 in., depending upon section and carbon content.

Furthermore, if the purchaser desires, he selects a rail from each 100 tons of material and a tensile test specimen is cut from the left center of the head. Retesting without prejudice is permitted if the fracture occurs outside the middle half of the gaged length. Tensile properties must conform to these relations:

	Ultimate Strength	Minimum Elongation in 2 In.
Ordinary carbons of any process	94 to 112,000*	15 to 12*
	112 to 119,000	10
Higher carbon open hearth	103 to 112,000	12
	112 to 123,000	10
Higher carbon bessemer	99 to 112,000	12
	112 to 119,000	10

* The minimum elongation for intermediate breaking strengths are in arithmetic proportion.

Retesting is permitted as follows: Two additional chemical tests may be made from the same heat or cast; if both pass, the entire 100 tons of rails is acceptable. If one or both fail, that individual heat is rejected, and the remainder of the lot of 100 tons treated and tested as a new lot. In this way the remainder of the lot is accepted as soon as a "cast" is found which passes the chemical test or retest. If the impact test fails, two additional tests may be made from two other rails. The heat is acceptable if both tests pass.

Retest for tensile properties follows the same procedure as retesting for chemical properties.

Ingots must be at least 200 sq.in. cross-section at the big end. They must be rolled bottom end ahead. All cold-straightening "shall be done by gradual pressure."

Storing Turpentine in Galvanized Tanks

Iron drums or tanks in which turpentine is to be shipped or stored should not be galvanized on the inside, but should be properly shellacked. This persistent white turbidity in turpentine was caused by a finely divided zinc compound held in suspension and a certain quantity of dissolved zinc. Iron oxide is also sometimes found in suspension. Shellacking instead of galvanizing will do away with this trouble.

It might be possible to ship or store freshly distilled turpentine, free from water, in iron or galvanized drums or tanks without producing this objectionable condition, but the smallest quantity of water will develop acids which partly dissolve and loosen either the iron itself or the zinc with which the iron has been galvanized. Turpentine stored over winter is practically certain to separate some water during the cold weather and any unshellacked metal surface will be attacked.

Modifications of the Sand Test For Detonators

By William M. Dehn

THE SAND TEST, as initiated by Snelling[1] and developed by Storm and Cope[2], is a rapid and practical method for measuring the explosive strengths of detonators and is based on the weights of 20- to 30-mesh standard sand crushed by their explosions. The fuse or electric detonators are imbedded in 100-gram masses of Ottawa sand contained in a suitably constructed bomb or explosion chamber of heavy steel. After the explosions, the weights of sand finer than 30 mesh are separated and weighed and the physical constants thus obtained are interpreted as the quantitative effects, or strengths, of the respective detonators.

Having had occasion recently to use the sand test and a number of questions relating to it having arisen, the writer was led to make a closer study of its operation and its principles. For example, Table I, calculated from a great volume of data of U. S. Bureau of Mines Technical Paper 125, shows remarkable regularities and raises a number of questions.

TABLE I—RESULTS OF SAND TESTS BY U. S. BUREAU OF MINES

No. Detonator	Average Weight of Charge	Percentages of Sand Retained on 40-Mesh	60-Mesh	80-Mesh	100-Mesh	Per Cent Sand Through 100-Mesh	Average Weight Sand Crushed	Sand Crushed by 0.1 g. of Charge
3	0.4953	14.93	18.11	10.64	6.94	49.38	22.03	4.44
4	0.6358	13.66	17.02	9.93	6.49	52.90	27.44	4.32
5	0.7220	13.11	17.06	10.10	6.61	53.12	30.90	4.27
6	0.9842	12.56	15.60	9.32	6.44	56.13	36.61	3.73
7	1.4377	11.89	15.07	9.27	6.04	57.73	47.16	3.28
8	1.8345	9.64	14.41	8.79	5.92	61.24	54.53	2.97
10	2.8691	8.12	12.69	8.64	6.16	64.39	68.74	2.40
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*

Why are the strengths[3] apparently not proportional to the weights of the detonators used? Why are they apparently less and less per unit of weight, as the total weights are increased? Then, on the other hand, with increase of size of detonators, why are larger percentages[4] of sand broken up more finely? Conversely, with decrease of charge of detonators, why are relatively larger fragments[5] obtained? These and other questions were raised by earlier experiments with the sand test. Much light on these questions has resulted from an extensive study of the test, especially from use of the modified form of apparatus described herein.

Modified Testing Apparatus

The essential features of improvement in the new form of explosion chamber are shown in the figure. The metal tripod support and the heavy frame carrying the screw to hold down the cover at the point *G* are omitted. The apparatus is a transformed autoclave[6] whose interior dimensions are 4 and 9 in. The only novel feature involved is the cylindrical steel weight, 5 in. in height and nearly 4 in. in diameter; it is centrally perforated by a ¼-in. bore *DC* and weighs 6 kg. In its final and most efficient form, the lower part of the weight was bored out hemispherically as indicated by the line *C*. Earlier forms, such as the flat-bottom form *A* and the partly cupped form *B* are indicated in the figure. The detachable hook is used to lower and to raise the weight.

Methods of Using Detonation Bomb

A 500-gram charge of Ottawa sand, freshly standardized to the 20-mesh and 30-mesh sieves to be used, is placed in the detonation bomb. The fuse or the wires of the attached detonator are passed through the hole of the weight at the cup end and the detonator is adjusted so as to touch the weight and maintain a vertical position. The weight with attached detonator, is then lowered by means of the hook *E*. After detaching the hook the weight is pressed down by hand so that the sand fills the cupped bottom; then the detonator is adjusted in the sand to a height estimated to be centrally and symmetrically located. By means of a gas pipe the weight is tamped down until the character of the sound of the blows indicates that the sand under the weight is uniformly and completely packed. This tamping should begin with moderate force and should not disturb the upright position of the weight. Finally, stronger blows of the pipe will give the desired compactness. The fuse or the wires are next run through the tube *F* of the cover, the latter is screwed down tightly and the charge is fired, preferably with the apparatus resting on a concrete floor. The explosions usually impart "kick" to the apparatus, but no sand is ejected therefrom. The cover of the bomb is taken off and the steel weight is elevated by the hook. The sand is then poured and brushed onto a stout piece of paper. No special precautions need be taken to collect the dust finer than 100 mesh.

Since only sand larger than 30 mesh and 100 mesh

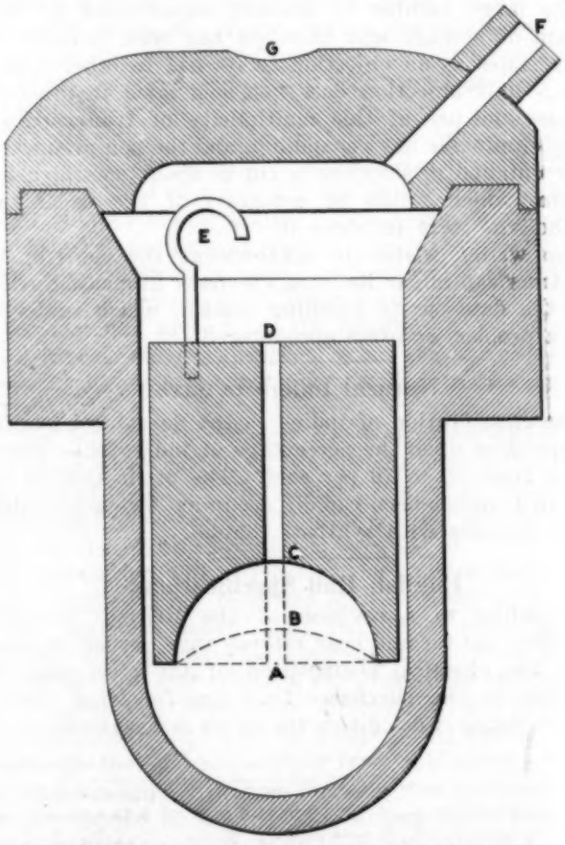


FIG. 1—CROSS-SECTION OF DETONATION BOMB

[1] *Proc.* Eng. Soc. Western Pa. p. 673 (1912).
[2] U. S. Bur. Mines Tech. Papers 125 and 162.
[3] Compare columns *b* and *i*.
[4] See column *h*.
[5] See columns *c* to *f*.
[6] The digestor or autoclave is supplied by the Palo Co., New York City, and is described as "made of copper, with bronze cover, cast steel yoke, sheet steel mantle for gas burner, with 3 legs, for 50 atmospheres working pressure."

respectively are weighed—the sand finer than 100 mesh being calculated by difference—no attention needs to be given to the dust inevitably lost to the air during the explosion or while transferring and sifting. The sand is first run through a 20-mesh sieve for the purpose of removing some of the pure white, extremely fine sand found to be in a packed condition, also to remove fragments of the fuse and detonator cap. All of this material is thrown away. Next the sand is poured onto a 30-mesh sieve. Since many masses of white crushed and packed sand are found, they are powdered on the sieve by means of a cork attached to a stick, using it as a flat-bottom pestle. These compact masses of powdered sand give trouble during the stages of sifting, but their removal is necessary to secure accurate and concordant data. After all of the 30- to 100-mesh sand has been collected, it is again run through the 30-mesh sieve by shaking but not by using the cork pestle. In this manner a quantity of 20- to 30-mesh sand will be recovered and this must be returned to the main bulk of 20- to 30-mesh sand, because the cork will always force through the sieve some sand which will not pass through by ordinary shaking.

In this connection it is of interest to note that under the microscope Ottawa sand is observed to be spherical or spheroidal in form, with no flat or conchoidal surfaces; but after explosions, unchanged sand, sand with one flat or conchoidal surface, and sand with two or more such surfaces are observed. The original round sand is extremely resistant to comminution by friction with the cork pestle; the sharp edges of the broken fragments are quite easily broken off. Hence the total sand crushed is subject to little effect by the pestle, but the percentage of the sand finer than 100 mesh may be varied through long-continued rubbing with the pestle. A blank run to determine the sand crushed by tamping in the bomb and by the rubbing with the cork under the above conditions gave less than 0.5 gram of sand from the 500 grams used.

Features of Improved Apparatus

The essential improvements of the detonation apparatus over that of Storm and Cope are as follows:

1. A heavy weight is superimposed on the charge of sand so as to subject the latter to more of the explosive strength of the detonator.
2. The weight is cupped at its bottom so that the detonator explodes in the center of a ball of sand, thus giving a more symmetrical distribution of the explosive effect of the detonator.
3. The charge of sand is 1 lb., or preferably 500 grams, instead of 100 grams, so as to supply a sufficient excess of material upon which the detonator can exert its power.
4. Only two fractions of sand finer than 30 mesh are determined; hence the practical application of the sand test is greatly simplified.

Other incidental details of improvement of this test are obvious or will be indicated.

Function of Weight of Bomb

In connection with the use of the weight over the sand subjected to the force of detonating charges, it may be observed here that 100 to 200 per cent more crushed sand can be obtained by this means than Storm and Cope obtained in their experiments. For example, their average for a No. 6 cap was 36.61 grams of sand, while the improved apparatus gives a value for the same cap of 85 grams. From these data and others given in the accompanying tables, it is evident that the greater confinement of the sand under a weight permits of utilization of more of the power of the detonator than could be secured in the Storm and Cope bomb with only 100 grams of unconfined sand. In their experiments most of the power of the detonators was dissipated in a sand bombardment of the walls of the bomb without subjecting all of the grains to the critical intensity force necessary to shatter.

Whereas, on the one hand, it is admitted that no known test for the strengths of detonators can measure all of the energy liberated, yet, on the other hand, any modification of a test like the sand test which gives a closer approximation to the total and true value is likely to be the more accurate and useful.

The mass of metal superimposed on the sand—namely, 6 kg.—in the apparatus described can be increased with accompanying increase of sand crushed. The total mass of metal thus used must be limited by estimates of the strength of the detonation bomb and of economy of the standard sand to be used, with incidental attention given to the control of gases developed so as to avoid blow-out of sand.

It was found that the cupped-out bottom gave substantially 25 per cent more crushed sand than the heavier but flat-bottomed weight. The effects of this form, therefore, is not only to lessen the ballistic effect on the weight but also to supply a symmetrical distribution of force lines of the explosive.

Details Regarding Sand Used

The quantity of sand to be used in the detonation bomb may be varied, but it has been found that 500 grams gives the desirable ball-like form in the bomb and for purposes of economy of sand and of reduction of labor in sifting this mass may be considered a good practical limit. The writer believes Storm and Cope used far too little sand in their experiment, since a No. 7 cap can break up more than the total sand used by them.

Tamping of the sand under the weight was found to be necessary to give concordant and maximum effects of detonation. Such tamping not only assures elimination of relatively large air spaces under the weight but also gives a packed condition of the sand amounting to about 5 per cent. Increase of compactness was obtained by mixing with small percentages of water. The incompressibility and capillarity of the water, as well as its displacement of air, increase the "hammer and anvil effect." Too much water, however, causes a decrease of demolition owing to diversion of explosive energy to heat of vaporization.

The convenience of measuring only two fractions of broken sand is obvious not only in lessening the labor of analysis, but the two fractions empirically chosen have been found to serve a definite and useful purpose. For example, it will be observed that the percentages of sand finer than 100 mesh as determined by Storm and Cope varied for the respective detonators from 49 to 65. The percentages of sand finer than 100 mesh as determined in accordance with the method of this paper have fallen usually between 40 and 55.

Why are there such wide differences, especially in the case of the large detonators as used by Storm and Cope? The answer is obvious—namely, incomplete detonation effect on the sand is indicated by a high percentage of sand smaller than 100 mesh. Evidently the

sand next to the detonator will be broken most finely, hence limited and incomplete effects will be indicated by higher percentages of the finer sand. Conditions that will produce this effect are: too little sand; too big a detonation charge; faulty confinement in the detonator capsules; imperfect exterior compression resulting in local blow-out; asymmetric installation of the detonator in the mass of sand, resulting in irregular distribution of the force lines of the explosive; variations in the shape and size of the detonators used; variations in the size and shape of the sand used.

The first of these two conditions are illustrated by the data of Storm and Cope; the effects of most of the other conditions are obvious; the effects of variations of the size and shapes of the detonators and of the sand used introduce a number of interesting questions.

Demolition Values Depend on Surface as Well as Weight

Since masses vary as the cubes and surfaces as the squares, it is possible that different weights of the same explosive cannot reveal by the sand test, or indeed by any test, strengths directly proportional to such weights. For example, assume that the explosive spherically occupies 1 c.c. and 2 c.c. respectively. Then the surfaces exposed will be in the ratio of 1 : 1.59 instead of 1 : 2, and the explosive power cannot be exerted under identical conditions of space distribution. Now, because the gas generated by an explosive, especially of the detonating type, exerts its power most intensely at the surfaces confining the explosive, while ballistic pressure effects are conducted to varying distances in advance of the expanding sphere of gases, it is evident that the total area of such surfaces initially exposed is a very important factor as influencing the final total effect. This is especially true when small weights are involved or when the explosives are highly brisant. Under these conditions, as the spheres of gases expand, the intensity factor falls off rapidly for a number of reasons, chief of which are the cube-square relation and the cooling by adjacent materials. Since a critical intensity factor is necessary to crush sand and other materials, it is evident that under adverse conditions of space distribution much of the energy of detonating explosives may be dissipated as heat or by transformation to ballistic effects. For example, in Table II it

TABLE II—RELATION OF DEMOLITION TO SURFACE AND WEIGHT

Det. No.	Ratios of Surfaces	Ratios of Weights	Surfaces	Weights	Sand Crushed S. and C.	Sand Crushed Dehn	Relative Strengths S. and C.	Relative Strengths Dehn
6	4.50	0.9842	1.00	1.00	36.61	85	1.00	1.00
7	5.77	1.4377	1.28	1.46	47.16	111	1.29	1.30
8	5.95	1.8345	1.32	1.86	54.53	135	1.49	1.59

is obvious that the sand test does not give values for demolition strictly proportional to the weights used, but values intermediate to the ratios of surfaces and the ratios of weights. It is further obvious that that test best measures the strength of an explosive which gives values most nearly proportional to the weights used. The cube-surface relation of explosives will be investigated further.

Study of Optimum Size of Sand

Investigation of the size of the sand used in this test brought out some very interesting observations which are shown in Table III. In study *A*, rounded Ottawa sand differing slightly in diameter gave more demolition with smaller grains—that is, with sand pos-

TABLE III—STUDY OF MAXIMUM CRUSHING EFFECT, USING NO. 8 DETONATORS

Study	No.	Condition of Sand Used	Total Sand Used	Sand Crushed	30 to 120 Mesh	Held on 120 Mesh	Per Cent Held on 120 Mesh
A	1	20 to 30 mesh. Through 20 mesh easily	500	135	79.5	55.5	41.11
	2	20 to 30 mesh. Through 20 mesh with difficulty	500	128	73.0	55.0	42.95
	3	20 to 30 mesh. Barely passes 20 mesh screen	500	117	66.5	50.5	43.16
B	4	30 to 40-mesh sand, fractured	500	251	....	80.0	31.87
	5	40 to 50-mesh sand, fractured	500	240	....	95.0	39.58
	6	50 to 80-mesh sand, fractured	500	154	....	83.0	53.89
	7	80 to 120-mesh sand, fractured	500	101	....	101.0	100.00

TABLE IV—ADDITIONAL RESULTS OF SAND TESTS

Study	No.	Conditions	Detonator No.	Sand Used	Sand Crushed	30 to 100 Mesh	Held on 100 Mesh	Per Cent Held on 100 Mesh
A	1	Detonators too long to be inserted completely in the masses of sand used. All detonators were old stock, somewhat deteriorated by storage in the moist air of the laboratory.	*a*	8	100	11.0	5	66	54.54
	2		*a*	8	200	69.0	26.5	42.5	61.60
	3		*a*	8	300	104.0	48.5	55.5	53.36
	4		*a*	8	400	109.0	51.0	58.0	53.21
	5		*a*	8	500	116.0	54.5	61.5	53.02
	6		*a*	8	600	123.5	57.0	58.0	53.79
	7		*a*	8	700	123.0	62.0	61.0	49.59
	8		*a*	8	800	118.0	58.5	60.0	50.85
B	9	New stock detonator *b*	*b*	6	500	88.0	49.0	39.0	44.32
	10	14 c.c. H_2O added to sand	*b*	6	500	103.5	60.0	43.5	42.03
	11	100 c.c. H_2O added to sand	*b*	6	500	87.0	48.0	39.0	44.94
C	12	Detonator not inserted deeply, but next to weight.	*b*	6	500	75.0	40.5	34.5	46.00
	13		*b*	6	500	76.0	43.0	33.0	43.42

TABLE V—ADDITIONAL DATA ON SAND TESTS

Study	No.	Conditions	Detonator No.	Sand Used	Sand Crushed	30 to 120 Mesh	Held on 120 Mesh	Per Cent Held on 120 Mesh
D	14	Bomb on concrete floor	*b*	6	500	85.0	50.5	34.5	40.58
	15	Bomb on wooden floor	*b*	6	500	83.5	50.5	33.0	39.64
	16	Bomb without heavy frame and resting on tin can	*b*	6	500	70.5	40.0	30.5	43.26
E	17	Extra weights in bomb	*b*	6	500	86.5	49.0	37.5	43.35
F	18	....	*b*	7	500	111.0	63.5	47.5	42.80
	19	....	*b*	8	500	135.0	79.0	56.0	41.50

sessing the greater surface exposed to the power of the explosive. This study emphasizes the necessity of using sand of narrow mesh variation; certainly if 20- to 30-mesh sand is used, it should be thoroughly mixed after running through the sieves.

From study *A* it may be concluded that sand finer than 20- to 30-mesh can be advantageously used for the sand test. This is neither proved nor disproved by study *B*, since only sand previously crushed by detonators was used therein. However, study *B* does prove that a limit to such fineness of sand is reached for maximum crushing effect and that this maximum probably lies between 30- and 120-mesh. It must be remembered that the crushed sand possesses flat conchoidal surfaces and partly cracked texture; hence the optimum fineness cannot be estimated accurately from the data given.

Since the total surface of a given mass of sand can be increased thousands of times through comminution, while the explosive intensity factor remains a constant, it is easy to understand that too fine a division of the sand will result in the following: Dissipation of energy over too large a surface, a lowering of the critical intensity factor below the value necessary for crushing, and in a conversion of such crushing force to heat and ballistic effects. Furthermore it may be assumed that the

optimum sand size will differ for different explosives, since the explosives themselves possess different intensity factors for crushing.

If this prove true, then the strengths of detonators of different compositions cannot be compared accurately on the basis of the values obtained with the same quality of sand. This and other related questions will be investigated. Miscellaneous data, illustrating the foregoing discussions and conclusions are given in Tables IV and V.

Summary

Sufficient sand should be used to yield a practical maximum of crushing. It should be rounded and of a diameter practically uniform and sufficiently small to approximate the optimum fineness for the detonator used. Sand recovered from one test should not be used for a second test.

Confinement of the sand should be effected by a heavy weight of special design and the whole should be tamped down to a maximum compression.

The detonator should be inserted symmetrically in the ball-like mass of sand.

Different weights of the same detonator, or indeed equal volumes of the same differing in density, cannot exert crushing effects on sand directly proportional to the weights used.

Comparisons of the strengths of different detonators, as determined by the sand test, are only approximate.

Seattle, Wash.

Legal Notes

By Wellington Gustin

Rule of Implied Warranties in Sales Enlarged by Uniform Sales Act

In the case of H. Klaff & Co. versus Luria Bros. & Co., Inc., Klaff brought suit to recover a balance alleged to be due for several carloads of metal sold and shipped between March 15 and June 5, 1920. The amount of this balance was admitted, the dispute being only as to the validity and amount of Luria Bros.' claim of set-off arising out of a previous sale of five carloads of steel shells by Klaff to Luria Bros., shipped from the Naval Proving Ground at Aberdeen, Md., to Luria Bros. at its yard in Reading, Pa., and reconsigned by them to the Carpenter Steel Co., also at Reading. The Carpenter company rejected three of the five cars and Luria Bros. tendered a return of same to Klaff, who refused to receive them. The claim of set-off was for the purchase price paid by Luria Bros. for the rejected cars, together with demurrage charges.

In this case the seller of the steel shells was a broker or dealer and not the manufacturer. Defendants defended on the ground that they were purchased as scrap steel for remelting and were unfit for that purpose. They further contended that the seller knew the purpose for which they were purchased, and therefore there was an implied warranty that such material was reasonably fit for that purpose.

Former Law of Implied Warranties

Much confusion arose over a rule of law established in most of the states prior to the uniform sales act and now modified by this act. In a suit of the Queen City Glass Co. against the Clay Pot Co. (97 Md., 429), the law of implied warranties was laid down. This was cited in a subsequent case (114 Md., 172) as follows:

"Where a manufacturer contracts to supply an article which he manufactures to be applied to a particular purpose so that the buyer necessarily trusts to the judgment or skill of the manufacturer, there is in that case an implied term of warranty that it shall be reasonably fit for the purpose to which it is to be applied. In such a case the buyer trusts to the manufacturer or dealer and relies upon his judgment and not upon his own."

Seller Included Under Uniform Sales Act

Now the uniform sales act puts the seller, who is not the grower or manufacturer of the thing sold, in the position which was formerly held by the manufacturer or grower only, in reference to the implied warranty of the goods sold.

Section 36 provides: "Where the buyer, expressly or by implication, makes known to the seller the particular purpose for which the goods are required, and it appears that the buyer relies on the seller's skill and judgment (whether he be the grower or manufacturer or not) there is an implied warranty that the goods shall be reasonably fit for such purpose."

In a former case it was held that "when the seller is not the manufacturer of the article sold and the buyer has an opportunity of examining it there is no implied warranty, in the absence of fraud, that it shall be fit for the purpose for which it was bought. In such cases, if there be no express warranty, the doctrine of *caveat emptor* applies, and the buyer not having seen fit to exact a warranty, takes upon himself the risk as to quality."

Distinction Between Dealer and Manufacturer Eliminated

The sales act in effect qualifies this doctrine of *caveat emptor*. Goods thus sold may be found to be merchantable and yet not reasonably fit for the purpose for which they were required and if the buyer relies on the seller's skill and judgment in selecting the goods the doctrine does not apply. The important distinction between the dealer's and manufacturer's implied warranties as to the quality of their goods was apparently wiped out and they now stand on common ground.

In Pennsylvania the question arose in the case of Griffin vs. Metal Products Co. and the Supreme Court of that state declared the law there to be settled. It construed a contract for the sale of high-speed steel; and the question whether there was an implied warranty that the steel should be reasonably fit for the purpose for which the seller knew it was to be used was decided in these words:

"Before the passage of the act [the uniform sales act] it had been repeatedly so held, so far as relates to the grower or manufacturer of the goods sold, and the only change made thereby was to extend the rule to every seller 'whether he be the grower or manufacturer or not.'"

The contrast is well set forth in Benjamin on Sales (6th English Edition), page 716: "The distinction taken at common law between cases where the buyer had an opportunity of examining the goods and those in which he had none . . . has been abrogated by the code [referring to the uniform sales act]. Instead of a presumption that a buyer, who might have in-

spected the goods, bought on his own judgment, in future whether he so bought or not will be a question of fact, and an opportunity of examination and even an actual examination will be immaterial. And no distinction is drawn by the code between contracts of sale of specific as distinguished from those of unascertained goods. At common law the buyer of a specific thing for a particular purpose took the risk of the fitness of the thing bought."

Further, it was contended by the seller that since the buyer had used two carloads of the steel shells it could not then rescind the contract and return the part unused, since it was admitted that there was no difference between the material in the cars used and that unused. But the court points out that the price of the goods was not a lump sum for the five carloads, but $25 per ton; and there was no evidence to show that the price per ton depended upon the quantity ordered, or that the seller was in any way injured by the failure of the buyer to return all the cars. The court says under these circumstances the failure to return all the shells would only bear on the buyer's good faith.

Rights of an Owner of a Trade Secret

Some of the rights of an owner of a trade secret are set forth in the recent case of the Cameron Machine Co. against the Samuel M. Langston Co. and others (115 Atlantic, 212). Here the complainant sought an injunction to restrain the defendant Sieg from divulging secret features of certain machines manufactured by it, and to restrain the defendant company and Samuel M. Langston from using any information respecting such secret features which they, or either of them, obtained from Sieg.

The two companies were competitors. From time to time each company placed upon the market new and improved types of their own special make machines. From 1915 to 1919 complainant had in its employ an erector named Schatten; and about October, 1919, Schatten entered the employ of the Langston company. The defendant Sieg was employed by complainant from March, 1917, to May, 1920, when he also entered the employ of the Langston company.

Claims Secret Features Were Disclosed to Competitor

The bill charged that the Langston company induced Sieg to leave the services of complainant for its own employ for the purpose of obtaining from him knowledge of the secret features which complainant had embodied in the design for two certain improved machines which Sieg had designed for it. It further charged that Sieg, in violation of his duty to complainant, disclosed to the defendant company the secret features of its own machines, which he had designed for it, and that the defendants thereupon designed and manufactured a similar machine, copying and making use of all the secret features of complainant's machines.

Defendants denied the charges against them and asserted that there were no secret features in complainant's machines; that most if not all of the so-called secrets were old in the art; that such had been used in their own machines years before the new types of complainant's machines. And they further asserted that the complete designs for complainant's new machine were not in existence at the time Sieg left its employ; and that the exhibits used to establish such similarity are fictitious designs made solely for the purpose of the case, and after it had become possessed of a completed design for defendant's machine.

From the evidence the court could not say with certainty that there were any secret features or elements of complainant's designs which Sieg appropriated and divulged to the defendant company and which are used or embodied in its new machine. Neither was there satisfactory proof that any such secret features existed. On these facts the Chancellor dismissed complainant's bill of charges.

Otherwise the case brought out an interesting proposition. A "trade secret" was defined to be "a plan, or process, tool, mechanism or compound, known only to its owner and those of his employees to whom it is necessary to confide it."

Injunction Will Lie Against Employee Divulging Trade Secrets

Now, if the employee comes into possession of such trade secrets through a confidential relation with his employer, the law will raise an implied contract to prevent him from divulging any information he may have obtained as to the trade secret.

In Stone versus Graselli Chemical Co. (55 Atlantic, 736), the court held that a manufacturer whose goods are made under an unpatented secret process is entitled to protection by injunction against the divulging of his secret in any proper case.

This case, as well as others, also adopts the principle that employees of one having a trade secret, who are under an express contract, or a contract implied from their confidential relationship to their employer, not to disclose that secret, will be enjoined from divulging the same to the injury of their employer, whether before or after they have left his employ, and that other persons who induce the employee to disclose the secrt, knowing of his express or implied contract not to disclose the same, will be enjoined from making any use of the information so obtained.

Secrecy in Industry Fools Only the Secretive, Says Geological Survey Head

"Experience in dealing with producers of different commodities has shown that secrecy is largely a method by which producers have been fooling themselves," says George Otis Smith, the director of the U. S. Geological Survey, who has had long contact with production statistics. "Those who really wish to know the scope of competitors' activities have plenty of ways to find out. Secretive operators, who eventually decided to change their methods, have been surprised very much on disclosing their secrets to find that these secrets already were well known to their competitors."

This comment was occasioned by correspondence with S. K. Colby, the president of the American Magnesium Corporation. There was some hesitancy as to whether the Survey's annual chapter on magnesium should be written, as there is only one company active in its production. Presumably the company is entitled to keep its results to itself. An effort was made, however, to get permission to use these figures so that the Survey's records would be continuous. In his reply furnishing the figures, Mr. Colby expressed his hope that the chapter would be printed, so as to record the progress in the industry. He stated that his company had nothing to lose by having the quantity of metal produced by it made public.

Mechanical Properties As Affected by Grain Size

Grain Boundaries Add a Certain Stiffness to the Metallic Aggregate — Fine Grain Therefore Generally Involves Higher Tensile Strength and Hardness, and Greater Reduction of Area — Maximum Elongation Requires Medium Grain Size

By Zay Jeffries and R. S. Archer

TWO recent contributions[1] have defined, in a general way, the mechanical properties of pure metals. It was also remarked that the structure of the metal had a very profound effect on the results to be had from various physical tests. The simplest type of structure, of course, is that where the entire sample consists of one huge crystal, consequently the properties of the individual crystalline grain were given.

We now purpose to discuss how variation in the average size of the crystalline grains comprising the metal may be expected to influence the mechanical properties of the aggregate.

Support at Grain Boundaries

The continuity of the planes of easy slip is broken at grain boundaries. Any movement of blocks or fragments of one grain is opposed by adjacent grains which because of their different orientations cannot yield easily in the same direction. Disorganized or amorphous metal which is probably present at the grain boundaries acts as an additional source of rigidity (at low temperatures). Above the recrystallization temperature flow takes place at the grain boundaries, so that they are sources of weakness rather than of strength.

The mutual supporting action of adjacent grains is shown clearly in Sykes' molybdenum wires, Fig. 1, where the grain boundaries stand out like joints in a piece of bamboo. It is evident that the supporting action is effective to a considerable distance within the grains. We should therefore expect a shortening of such grains to result in an increase in strength, even though they still extended across the entire section of the wire. When the number of grains on the cross-section is also increased, the supporting action becomes still greater. Thus at 300 deg. C. Sykes obtained the following values for tensile strength vs. grain size:

Average Grain Diameter	Tensile Strength Lb. Per Sq.In.
Single grain	32,000
0.0011 in.	51,000
0.0002 in.	96,000

This increase in strength (and hardness) with decrease in grain size is characteristic of metals below their recrystallization temperatures. The quantitative relation of strength to grain size varies with the metal involved, the temperature of test, the rate of loading and the size of the piece, since it is not only a question of absolute grain size but also of the number of grains on the cross-section. When the number of grains on the cross-section is fairly large, however (say 1,000 or more), the absolute grain size is the important thing.

In the tests reported by Carpenter and Elam,[2] which were carried out at room temperature, the tensile strength of single crystals of aluminum of 99.6 per cent purity was found to vary from 6,270 to 9,180 lb. per sq.in. The same material treated to produce an average grain diameter of 0.0667 in. had a tensile strength of 10,440 lb. per sq.in., an increase of 66.5 per cent over the lowest and 13.7 per cent over the highest value for the single grains.

A most thorough correlation of grain size and Brinell hardness, measured at room temperature, has been worked out for alpha brass (68:32) by Bassett and Davis.[3] This alloy consists structurally of a single homogeneous solid solution, and is quite comparable to a pure metal. Some typical values obtained in one series were:

Average Grain Diameter	Brinell Hardness
0.014 in.	41.7
0.0046 in.	49.2
0.0030 in.	52.4
0.0014 in.	62.4
0.00093 in.	77.4

Observers are sometimes surprised to find that a very apparent difference in the grain size of two specimens is not accompanied by any marked difference in hardness. Referring to the second and third specimens in the table above, it will be seen that an increase in grain diameter of over 50 per cent has decreased the hardness only about 6 per cent. The difference in grain size would be quite apparent under the microscope, while the difference in hardness would be noticed only by measurements made with rather more than ordinary care. On the other hand, a similar increase in grain size between the last two specimens is accompanied by a marked difference in hardness. The effect of a given percentage difference in grain size is greater the smaller the grains.

Grain Size vs. Hardness at Higher Temperatures

When ductile metals are broken "cold"—that is, below their recrystallization temperature—fracture normally takes place through the grains and avoids the grain boundaries. At temperatures just under the melting point, metals are quite weak and fracture is intergranular. There is a range of temperature above that of recrystallization in which either transcrystalline or intergranular fracture may be produced at will by varying the rate of loading and duration of load. Slow loading and prolonged application of load favor intergranular fracture at low unit stress.

[1] "Mechanical Properties of Commercial Iron," *Chem. & Met. Eng.*, vol. 27, No. 14, p. 694, Oct. 4, 1922. "Effect of Temperature, Pressure and Structure on the Mechanical Properties of Metal," *Chem. & Met. Eng.*, vol. 27, No. 15, p. 747, Oct. 11, 1922.

[2] "The Production of Single Crystals of Aluminum and Their Tensile Properties," *Proc. of Royal Society*, A, vol. 100, 1921; abstracted in *Chem. & Met. Eng.*, vol. 26, p. 514, March 15, 1922.

[3] "A Comparison of Grain Size Measurements and Brinell Hardness of Cartridge Brass," W. H. Bassett and C. H. Davis, *Trans.*, A.I.M.E., vol. 60, p. 428.

Under these conditions the grain boundaries are sources of weakness rather than of strength. Accordingly at high temperatures the relation between strength and grain size is reversed, and the large-grained specimens are the harder. There must then be an intermediate temperature at which strength and hardness are little affected by grain size. This is the "equicohesive temperature." The following account of some experiments is taken from a paper by one of the authors:[a]

"Tests have been made on iron, tungsten, platinum, gold and silver. Small wires of these metals were drawn to a diameter of 7 to 8 mils in such a manner that the structures were fibrous—that is to say, a considerable amount of working on these metals was performed at temperatures below their annealing temperatures. Some pieces of each of the wires were heated by the passage of electric current, the temperature and time conditions being maintained in such a manner as to cause recrystallization and to produce one set of each of the metals composed of small equi-axed grains and another set composed of large equi-axed grains. The fine-grained and coarse-grained samples of the same material were compared with respect to the resistance to bending at various temperatures. Small hairpins were formed from each of the wires. Let us take the pair of silver wires as an example. The arms of each hairpin were 2 in. long and the distance between the two ends was ½ in. A clamp consisting of two steel bars was used to hold the hairpins. Two hairpins, one of fine-grained and the other of coarse-grained silver wire, were put in the clamp a short distance apart. It was found that a rider weighing 0.2 gram suspended on the ends of the hairpins would not cause a permanent deformation in either the fine-grained or coarse-grained samples at room temperature, but would cause permanent deformation of the wires at slightly higher temperatures. The steel clamp holding the two silver hairpins in a horizontal position was inserted in a muffle furnace and the temperature was gradually raised. At temperatures lower than 250 to 275 deg. C. the fine-grained silver wire was the stronger—that is, it would hold the given weight with less deformation or bending than would the coarse-grained silver wire. Above 275 deg., however, the fine-grained silver wire had been deformed or bent to a greater extent than the coarse-grained one. The conclusion is that the fine-grained and coarse-grained silver had the same resistance to deformation at 250 to 275 deg. C.; that at temperatures less than this the fine-grained silver has the greater resistance to deformation, while at higher temperatures the coarse-grained silver has the greater resistance to deformation. These tests were performed with the other metals named and the results are given in Table I. The iron and tungsten wires were heated with electric current in an atmosphere of hydrogen in order to prevent oxidation. The temperatures were measured with an optical pyrometer. The gold and platinum wires were heated in a muffle, the same as the silver, and the temperatures were measured with a thermocouple.

TABLE I

Kind of Wire	Diameter, In.	Equicohesive Temp., Deg. C.
Iron	0.007	550 to 600
Tungsten	0.007	1350
Silver	0.0075	250 to 275
Gold	0.0085	275 to 300
Platinum	0.0075	525 to 550

"The wires used for the hairpin tests were examined microscopically to make certain that the heat-treatment had produced the desired grain size. The fine-grained wires were made by heating the cold-worked wires quickly to a temperature considerably above that of recrystallization and the coarse-grained samples were produced by heating slowly through the recrystallization range followed by heating to a temperature near the melting point. The heating was done by passing electric current through the wires."

It will be noted that the equicohesive temperatures found for these metals correspond closely with their respective temperatures of recrystallization. This relation is a general one, having been found to hold for all metals investigated. Some experiments on zinc, lead and tin, which recrystallize at or below room temperature, are interesting. Quoting again from the paper mentioned above:

"Some pure zinc, lead, tin and aluminum were cast in such a manner as to produce coarse-grained structures. One piece of each of the castings was tested for Brinell hardness as cast and one piece of each was cold-hammered, after which the Brinell hardness was determined. The cold-hammering of the zinc was continued until cracks began to form at the edges of the piece. In testing for hardness, 500 kg. pressure was used with the zinc and aluminum, 200 kg. with the tin, and 100 kg. with the lead.

"It was noticed with all of the samples with the exception of the aluminum, that when the load was brought up to the required amount the beam of the balancing mechanism of the Brinell machine would very quickly fall. When the pressure was again brought up to that required, say for the zinc 500 kg., the beam would again drop. This means that the pieces of lead, zinc and tin were gradually deforming under constant load. The pressure was maintained at the required amount until the beam at a constant position of the specimen table would remain in a substantially constant position.

"With both cast and cold-hammered aluminum, the beam remained in a substantially constant position after the load was first brought to the required amount. A very slight lowering was noticed, but the effect of increasing the time of exposure of a given load was practically nil on the resulting hardness.

"This slow deformation was the most marked in the tin. It was more pronounced in the cold-hammered samples than in the cast samples and the maximum effect was found in the cold-hammered tin. When the hardness tests were carried on in such a manner that there was substantially no further deformation in the pieces of metal with constant load, it was found that the cold-hammered aluminum was harder than the cast aluminum, whereas the cold-hammered lead, tin and zinc were all softer than the same metals in the cast state.

"To obtain an idea of the rate of deformation of the pieces of lead, tin and zinc, the diameter of the impression of the ball of the Brinell hardness machine was measured on each of the samples after the load had first registered the required amount. For example, the tests on zinc were made as follows:

"The piece of cast zinc was put in the Brinell machine and the pressure raised quickly to 500 kg. Then the piece of cold-hammered zinc was inserted in the machine and the pressure raised to 500 kg., the rate of application of the load being the same in both cases. The hardness numbers were then calculated. It was found that the hardness of the cold-hammered pieces of aluminum, zinc, lead and tin was greater when determined in the above manner than that of the same metals in the cast state. The results of the hardness tests are given in Table II.

TABLE II—HARDNESS OF WHITE METALS, CAST AND HAMMERED

Material	Pressure in Kg.	Load Sustained: Diam. of Impression in Mm.	Load Sustained: Hardness	Quick Release of Load: Diam. of Impression in Mm.	Quick Release of Load: Hardness
Cast aluminum	500	4.75	26.5	4.75	26.5
Cold-hammered aluminum	500	3.70	44.8	3.70	44.8
Cast zinc	500	4.15	35.3	3.65	46.2
Cold-hammered zinc	500	4.20	34.5	2.90	74.0
Cast lead	100	4.85	5.10	4.70	5.44
Cold-hammered lead	100	5.05	4.66	4.30	6.54
Cast tin	200	5.65	7.30	5.10	9.12
Cold-hammered tin	200	6.8	4.72	4.6	11.32

"It is known that the equi-axing temperature of zinc after severe cold-work is not far below room temperature, and the hardness results would indicate that the equicohesive temperature of zinc would be only slightly below room temperature. The equi-axing temperatures of severely cold-worked lead and tin are considerably below room temperature, and the hardness results given in Table II would indicate that their equicohesive temperatures would also be considerably below room temperature. The equi-axing temperature of severely cold-worked aluminum is about 200 deg. C. with 1 hour's exposure at that temperature. The hardness results in Table II show that the equicohesive temperature of aluminum must be considerably above room temperature."

The lead and tin referred to as "cold-hammered"

[a] "The Amorphous Metal Hypothesis and Equicohesive Temperatures," Zay Jeffries, *J. Am. Inst. Metals*, vol. 11, p. 300.

were found by microscopic examination to be fully recrystallized, and therefore representative of normal fine-grained metal as distinguished from the coarse-grained cast specimens. It may be added that the duration of "sustained" load in the tests reported in Table II was about 15 minutes for the aluminum and about 1 hour for each of the other metals, while "quick release" was in each case after approximately 10 seconds.

These results bring out in a striking way the fact that the equicohesive temperature, as well as the recrystallization temperature, is dependent on the time factor. The temperatures at which the Brinell hardness is independent of the grain size are, for lead and tin, above room temperature for rapid loading but below room temperature for slow or prolonged loading. The equicohesive temperature of copper has been found to lie above 950 deg. C. for rates of loading producing rupture in about 3 seconds, whereas for very slow loading it is in the neighborhood of 300 deg. C. In general the equicohesive temperature is higher the more rapid the application and the shorter the duration of load.

Grain Size vs. Elongation

The elongation found on single-crystal test-bars of aluminum by Carpenter and Elam ran up to 87 per cent, as compared with about 37 per cent on bars with an average grain diameter of 0.0067 in. When there were two or three crystals on the cross-section, the elongation was less than 87 per cent, but greater than the elongation on the fine-grained bars. In Sykes' tests on molybdenum wires[5], on the other hand, the elongation was less on the wires composed largely of single crystals than on other wires of smaller grain size. These results are not contradictory, as the conditions of test were different. The gage length of the molybdenum wires was eighty times the diameter, and the elongation measured was the general elongation. Furthermore, the gage length included several grain boundaries, at which, as we have seen in Fig. 1, the deformation was relatively slight. Carpenter and Elam used test-bars in which the ratio of gage length to cross-section was relatively small, so the measured elongation was greatly increased by the high reduction of area, and the gage length consisted entirely of a single crystal. If the elongation on the molybdenum wires had been measured over the single crystal in which the break occurred, the per cent elongation would have been much higher. Unfortunately no tests have been made on single crystals having a sufficiently great ratio of gage length to diameter so that the general elongation could be measured, unaffected by the local stretch.

FIG. 1—SINGLE GRAIN MOLYBDENUM WIRE BROKEN IN TENSION (SYKES)

In general the grain size conducive to maximum elongation is neither extremely fine nor extremely coarse. The actual grain size which will give the highest elongation for any particular metal depends on the size and shape of test-piece, the temperature of test, and rate of loading. Curves given in Fig. 2 show how the relation between grain size and elongation in molybdenum depends on the temperature. The fine-grained wire, which had the greatest elongation at temperatures below 200 deg. C., had the least elongation at 900 deg. C.

The effect of grain size and diameter of test specimen on the elongation and reduction of area of Armco iron is shown in Table III.

TABLE III—EFFECT OF DIAMETER AND GRAIN SIZE ON TENSILE PROPERTIES OF ANNEALED ARMCO IRON

Diameter, In.	Grains Per Sq.In.	Tensile Strength, Lb. Per Sq.In.	Elongation, Per Cent in 2 In.	Reduction of Area, Per Cent	Number of Grains Across Diameter of Wire
0.204	400	41,000	30.0	76.0	100
0.025	810	48,550	12.5	76.0	18
0.023	2680	48,200	23.7	78.0	30

Table IV shows the required tensile strength and elongation of annealed copper wires of various diameters as specified by the American Society for Testing Materials.

TABLE IV—TENSILE STRENGTH AND ELONGATION REQUIRED IN SOFT ANNEALED COPPER WIRE

Diameter, In.	Tensile Strength, Lb. Per Sq.In.	Elongation, Per Cent in 10 In.
0.460 to 0.290	36,000	35
0.289 to 0.103	37,000	30
0.102 to 0.021	38,500	25
0.020 to 0.003	40,000	20

Lower elongation in small wire and thin sheet or strip is a general observation in metals. But as shown in Table III, a small grain size seems conducive to high elongation in small wire or thin strip.

Brittleness

Brittleness in metals may be due either to brittleness of the grain boundaries or to lack of plasticity in the crystals themselves. Equi-axed tungsten breaks in a brittle manner at temperatures below 200 deg. C., the

[5] "Effect of Temperature, Deformation, Grain Size and Rate of Loading on the Mechanical Properties of Metals," W. P. Sykes, *Trans.*, A.I.M.E., vol. 60, p. 780.

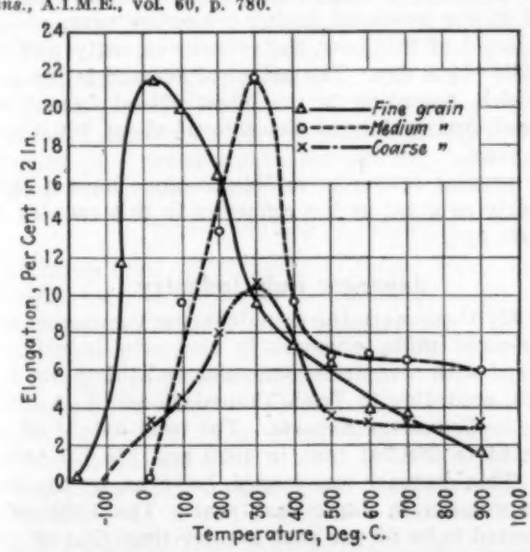


FIG. 2—EFFECT OF TEMPERATURE AND ELONGATION OF ANNEALED MOLYBDENUM WIRE. (SYKES)

fracture taking place almost entirely at the grain boundaries. Individual crystals of tungsten appear to be somewhat plastic. The low-temperature brittleness is therefore due to brittleness at the grain boundaries, a condition which is consistent with the view that the grain boundary metal is amorphous and that the amorphous metal increases in hardness and brittleness, as the temperature is lowered, more rapidly than does the crystalline. Coarse-grained zinc is but slightly ductile at room temperature, whereas fine-grained zinc may have an elongation as high as 90 per cent. In the coarse-grained zinc, the fracture takes place largely through the grains. Both fine-grained and coarse-grained zinc are brittle in liquid air, the fracture again taking place chiefly through the grains. Brittleness in this case is therefore due to lack of plasticity in the crystalline grains themselves. In either case small grain size favors the retention of ductility at low temperatures.

Reduction of Area

The first yielding of a tensile test-bar of a ductile metal involves a local reduction in the cross-sectional area. The stress intensity at this point is then higher than in the rest of the bar, which has not yet yielded. If it were not for the work-hardening effect of this slight local deformation, the reduced section would not be able to sustain a load sufficient to deform the remainder of the bar, so the section would continue to reduce and rupture would finally occur at this point, without any general extension of the bar as a whole.

A certain minimum rate of work-hardening is necessary for general extension to take place. Suppose the first local yielding reduces the cross-section of the bar by 1 per cent. Then unless the yield point of the metal is raised slightly more than 1 per cent by this deformation, the reduced section will not be able to sustain even the load which originally caused it to yield, and which was *insufficient* to cause yielding in the remainder of the bar. If the yield point is raised more than 1 per cent, then an increase in load will cause further deformation to occur at some other point in the bar. This process results in general extension, or general elongation.

Usually a stage is reached at which the rate of hardening is not sufficient to shift automatically the location of the yielding. The bar then necks down and breaks.

As long as general extension is taking place, the *load* on the bar must be increasing. When necking begins, the load can no longer increase. It may remain fairly constant for a while and must then decrease. The load per unit area of the reduced section, however, may continue to increase.

The total reduction of area at fracture is thus made up of two parts: (1) A reduction corresponding to the general extension before necking begins; the volume of the metal remains practically constant. (2) A local contraction at the point of fracture.

It will thus be seen that a rapid rate of hardening by deformation favors general extension rather than local reduction of area. Manganese steel is a typical example of a material which shows a high general elongation with little local reduction. It is also characterized by rapid hardening under deformation. Bronze behaves in a similar manner. Brass shows a greater tendency to neck down, but much less so than pure copper, which hardens less rapidly by deformation.

An extreme case is represented by glass at such a temperature that it is fairly soft. Pulling a glass rod in this condition results in a break with practically 100 per cent reduction of area and little general elongation. The glass does not become harder as a result of the deformation. If a hot rod of glass is withdrawn from the source of heat and pulled apart, there is apt to be very high general extension, because the points which are reduced in cross-section strengthen themselves by becoming cooler. If they remained at the same temperature, rupture would occur at the first point to yield and general drawing out would not be possible.

At high temperatures metals somewhat resemble soft glass, since the hardening effect of the deformation is removed by spontaneous annealing. Some annealed copper wires tested at room temperature showed a general elongation of 24.5 per cent with a reduction of area of 76 per cent. When broken at 950 deg. C. at such a rate that rupture occurred in 5 seconds, the elongation was 17 per cent and reduction of area 98 per cent, a considerable increase in reduction of area with a decrease in elongation.

Reduction of area of single crystals tested in the intermediate zone of temperature is very high, approaching in some cases 100 per cent. On the other hand, when there are a small number of grains to the cross-section of a test-piece, conditions appear to be unfavorable for high reduction of area. If the grain size becomes still smaller, the reduction of area increases. Extremely small grain size, such as probably exists in hardened steel, is unfavorable to plasticity of any kind, so that theoretically a point must be reached where further reduction of grain size no longer results in increased reduction of area in the tensile test. This point is apparently not reached in recrystallized metals; ordinarily the reduction of area is greater the smaller the grain size.

Increase in Oil-Refining Capacity

The oil-refining capacity of the United States has increased 813 per cent in 16 years, according to the American Petroleum Institute. The increase has, of course, been brought about largely by the demand created by the internal combustion engine.

In 1906 the refineries of the United States, running to capacity, could handle about 219,000 bbl. of crude petroleum a day. The principal demand was for kerosene. Gasoline was a byproduct and only about 8,000,000 bbl. of it was produced during the entire year.

On Jan. 1 of this year, the refinery capacity was over 2,000,000 bbl. a day. The principal demand is for gasoline which, according to the latest official figures, was produced during July at the rate of about 160,000,000 bbl. a year.

The present refineries in Mexico alone have a capacity nearly as great as the refineries in this country had 16 years ago.

Japanese Pulp Industry

In 1921 there were thirteen Japanese companies, with twenty-eight mills, engaged in the pulp industry, as compared with seventeen companies and thirty-one mills in 1920, according to Trade Commissioner H. A. Butts, Tokyo, to *Commerce Reports*. The total output of pulp amounted to 268,261 tons in 1920 and 250,027 tons in 1921. This decrease was caused, however, by the financial depression in Japan last year. The 1922 output is expected to be 30 per cent greater than that of 1920, and in the near future the Japanese production of pulp will probably exceed 400,000 tons annually.

Modern Practice In Manufacture and Applications of Steamed Ground Wood

The Present Status and Practical Possibilities of This Process of Paper and Board Manufacture—Part I, in Which the Theory of the Process Is Discussed and the Equipment Is Described

By A. O. Bragg

THE SCANDINAVIANS and Germans, and other European paper makers to a smaller extent, have made papers and boards from steamed mechanical pulp alone or with other pulps for over 25 years. In fact, certain kinds of papers made entirely from this material form important lines in their domestic and foreign trade. Fry, in Germany, seems to have been the first to steam wood in the log before grinding and the first to discover that the action is largely one of hydrolysis. Since that time, in 1867, refinements and improvements have been made so that some American mills, even with the higher labor costs, are carrying out the process with success. However, there seems to be a scarcity of information available in the pulp and paper literature regarding modern practice of this kind of ground-wood manufacture, and it is the object of this article to discuss the theoretical considerations on which its economical and effective operation must be based and to detail successful American practice in equipment, operation and applications. In Scandanavia and Germany the practice is to handle the wood by manual labor. Moreover, the equipment used is not particularly adapted to large production. For these reasons, European methods are not applicable here.

Unless the various methods of heat-treating wood with water before grinding are well defined and differentiated, there is likely to be confusion in referring to them, especially in view of the limited practice of this operation in America. Certain literature mentions as a variety of this process the simple soaking of the logs in hot water for a short time for loosening the bark, whereas in purpose and effect it is totally different, in that no appreciable hydrolysis or chemical change is effected in the wood. Such changes are essential to obtain pulp with the characteristics of the true steamed ground-wood pulp. This soaking process is simply a well-known preliminary operation to barking, often carried out to melt ice as well as loosen the bark. Treating logs in boiling water at 212 deg. F. for several hours causes hydrolysis and chemical changes, but to a much smaller degree than those brought about by steaming the wood—the most efficient and practical method for causing such changes.

Tests on Cooked Spruce

Thickens and McNaughton[1] from their extended grinding tests on spruce at the Forest Products Laboratory presented the following summary:

1. Cooking spruce prior to grinding results in a stronger fibered pulp, although at least 25 per cent more power per ton is required than is used for grinding untreated woods. The horsepower consumption per ton when grinding under conditions of varying cylinder pressure decreases to a minimum at approximately 65 lb. pressure on a 14-in. cylinder; this holds for dull or sharp stones.

2. When wood is cooked under conditions of constant pressure and varying lengths of time, the maximum power consumption per ton of pulp is obtained after cooking for 6 hours. This holds true, regardless of the pressure at which the cooking takes place, between zero and 75 lb. pressure.

3. Wood which is cooked at high pressure requires more power per ton of pulp when ground under the same conditions of cylinder pressure, speed and surface of stone than wood which is cooked at lower pressure, if the duration of the cook is the same. Likewise, the production of pulp in 24 hours is materially less when the wood has been cooked at high pressure than if it had been cooked at low pressure.

4. The yield per cord is influenced very greatly by the length of time the cooking is carried on and the pressure of the cook, being much lower for high pressures than for low and also for long cooking periods than for short.

5. The power to the grinder increases with speed and pressure of grinding and decreases with the degree of sharpness of stone. There is also a very slight increase in the power required with increases in temperature, other conditions remaining constant, while the thickness of stock in the grinder pit has almost no influence. Under like conditions of all other factors, the power to the grinder is less for steamed wood than for green or seasoned wood untreated.

6. With a fixed amount of power to the grinder and a fixed grinding pressure, the speed of the pulp stone will vary greatly, depending on the length of time the wood has been steamed and the steaming pressure. Unsteamed wood will grind at low speed, while that steamed a long time will grind at high speed with the same amount of power in the grinder.

7. There is little if any difference in the quality of pulp obtained as a result of using either the boiling or steaming process. The color, length of fiber and yield are practically the same if the boiling or steaming is carried on at the same temperature.

8. The amount of pulp produced in grinding cooked wood with a fixed amount of power to the grinder is less at high pressure and low speed than it is at low pressure and high speed. This results in a greater horsepower consumption per ton of pulp at high pressure and low speed.

Steaming Versus Boiling

It will be noted (paragraph 7) that similar results are obtained either by boiling or steaming the logs, at the same temperature. For practical reasons, steaming is practiced almost to the exclusion of boiling. In the first place, whether the water be added to the cooker already heated to 212 deg. F., or added cold and then heated in the cooker, much steam must be wasted in either case in heating it. In cooking with steam alone, its heat is given up directly to bringing the logs to its

[1] Bulletin 343, U. S. Department of Agriculture, 1916.

temperature. Secondly, while the steam left in the boiler after steaming can be blown off and its heat reclaimed by absorbing in boiler feed water, the water remaining from the boiling process is too contaminated with acids and dissolved matter to permit its being used for steam generation by the power plant. While it is possible to save hot water from a boiling and use it for the next batch, this involves expense for pumping and mechanical complications which makes the scheme too expensive.

The Enge and Bache-Wiig methods (see below) involve the use of auxiliary vacuum and compressing machinery which adds to the cost from investment, power, maintenance, labor and the low mechanical efficiency of vacuum and compressing machinery. However, these inventors claim to produce white or natural-colored ground wood. If the increase in strength effected in the pulp by these methods is comparable with that produced by simply steaming the wood, the extra cost would be to a large extent compensated, though in installing these or any other kind of ground-wood treating methods, all the pertinent factors would have to be considered. It will be evident that as a practical and economical mill proposition, the steaming is much superior to the boiling method.

Theory of the Process

When wood is treated in water, either as steam or in the liquid state, at temperatures of 212 deg. F. or over, several effects are produced more or less simultaneously. These include partial solution of the water-soluble materials, organic acids, alcohol, gums, mucilage, sugars, tannin, etc., amounting to 4.83 per cent in spruce and 1.88 per cent in yellow birch (Griffin and Little), and the softening into a gelatinous, adhesive condition of the remaining gums and mucilages. Hydrolysis by the water of the lignine components of the wood, aided by the organic acids liberated, also takes place, which in fact is the action described in Fry's patent referred to above. This hydrolysis is only partial and its extent is determined by the reverse reaction which is aided by oxidation. This oxidation, which occurs along with the hydrolysis, not only slows up and finally stops it but produces the brown color characteristic of the pulp. These coloring matters would be rendered soluble in the sulphite process and would not discolor the pulp, but with steaming alone they are not removed and cannot be removed subsequently without injury to the wood and excessive loss.

These reactions, with the rosin and pitch removal and the temperature actions noted below, cause a loosening of the fibers in the wood structure, so that the stones do not disintegrate them so much. That is, the grinding is more an action of shredding and pulling the fibers from the wood in more nearly their original length, and less of cutting them out of the wood as in the grinding of untreated wood. This greater average length of fibers and their greater pliability caused by the softening effect, the smaller amount of wood flour and torn pieces of fiber formed, together with the cementing effect of the gelatinized incrusting matter—gums, mucilage, etc.—give the pulp its unusual toughness and tensile strength.

Steaming, carried far enough, will entirely remove the rosin and pitch from even the most resinous and pitchy woods, such as Southern pines, jack pine and balsam fir; whereas if such woods are simply boiled in water at atmospheric pressures or are understeamed, much will still remain in them and cause trouble by clogging the paper machine wire. Rosin is now being completely eliminated from scrub pine and white pine by steaming for 9 to 16 hours at 13 to 20 lb. pressure according to the moisture content of the wood. During these cooks there is a pronounced resinous odor present, especially when a charge is dumped and steam escapes. Rosin softens at 212 deg. F. and melts at 307 deg., while steam at 13 to 20 lb. gage ranges from about 250 to 260 deg. F. After steaming, the logs are found to be split and cracked lengthwise. Considering these facts and the insolubility of rosin in water or organic acids, it would seem that at these temperatures all or part of the rosin must be hydrolyzed by the steam, perhaps assisted by the organic acids liberated, the product obtained from this reaction being volatile at these temperatures. It would seem, furthermore, that rosin, softening at 212 deg. F., would be sufficiently softened at 250 to 260 deg. F. to seep out of the wood through the seams and cracks which are opened up by the heating. Moreover, these openings probably permit much more penetration of the steam and thus expedite the reactions, no matter what wood is being treated. Experience proves that boiling the wood at 212 deg. F. (atmospheric pressure) will not remove the rosin and pitch, and understeaming does not permit complete penetration of the steam, so that some rosin still remains in the wood.

Another factor seems to be of great and even fundamental importance. This is the density of the wood, in weight of bone dry wood per cubic foot. On this basis, the density is, of course, independent of the greenness or dryness of the wood and is practically a constant for any given species. The necessity for careful consideration of the density of the wood steamed will be evident from the citation of an actual experience which came under the writer's observation.

Importance of Density

It was desired to discover the most effective steam pressure and cooking period to apply to loblolly pine in order to eliminate all rosin and obtain an extremely tough board. Certain of the Southern pines are being successfully steamed commercially for 9 to 16 hours at 12 to 20 lb. pressure, but the species cooked are unknown; in fact in this case it is not known whether one or more than one species are used. The best that could be done, therefore, was to treat the wood under the same conditions in expectation of obtaining similar pulp. However, after so treating a carload of the supposed loblolly pine, grinding and making into laps, instead of the strong brown pulp desired, a comparatively weak, brittle, reddish-cream colored pulp in which there was still much rosin was obtained.

A compilation of the densities of the different Southern pines from the data of the Forest Products Laboratory showed that they varied widely as follows:

	Density, Lb. Per Cu.Ft.
Loblolly pine (*Pinus tæda*)	30
Longleaf pine (*Pinus palustris*)	34
Pitch pine (*Pinus rigida*)	29
Scrub pine (*Pinus virginiana*)	26
White pine (*Pinus strobus*)	22

Considering that good results are being obtained by steaming "Southern pine" under the above conditions and that their duplication on loblolly pine failed to give the same quality of pulp, the only explanation is that the wood alone must have caused the divergence in

results and that the same species of wood was not used in both cases. The wood tested experimentally weighed 4,800 lb. per cord and had a density of 28.45 lb. per cu.ft., which, allowing for the probable better sampling by the Forest Products Laboratory in its determinations, corresponds to the density of pitch pine instead of loblolly pine, which it was supposed was being cooked. Moreover, from obtaining such different results from steaming Southern pines of similar moisture contents under similar conditions, it seems logical to attribute this divergence solely to the difference in densities of the woods in the two cases.

Accordingly, it would seem in general that to obtain pulp of the same average fiber length and color, the greater the density of the wood the more drastically must it be cooked, either by an increase in the steam pressure or temperature, or in the time of cooking, the former plan being the more practical. It would seem logical that the heavier and more dense the structure of the wood the higher the steam pressure necessary to effect penetration, expand it and open up seams and cracks, thus permitting complete action of the steam and temperature on all parts of the interior of the logs and also the escape of volatile and softened matter. It is the writer's opinion that woods of about 27 or 28 lb. per cu.ft. density should be steamed with a minimum of 35 lb. pressure for 20 hours, and higher density woods in proportion.

However, other factors besides the density must be considered in deciding on any cooking policy. Since, like any digestion process, the action takes place in two stages, the greener the wood the more drastic must be the cook for any given species. The first stage is that in which the wood is brought up to steam temperature and the second that in which the actual digestion and chemical changes occur and the steam supplied simply replaces the heat lost by radiation. The large amount of water in green wood must be heated up to steam temperature before any hydrolysis takes place, and this consumes time and steam. The moisture content of the wood can be regulated to some extent by felling it in the fall when sap is down and letting it season thoroughly before use.

Equipment

Wood Room

Nothing unusual is necessary in the way of wood-preparing equipment, any standard machinery for cutting the wood into 2-ft. lengths being used. This machinery should preferably be on the same floor level as the rotary boilers when these are used, or as near the top of vertical digesters as possible, to reduce power and investment required for conveying and elevating wood. Barkers may or may not be required according to conditions. See "Operation."

Steamers, or Digestors, and Conveyors

Two types of steamers are used commercially in America—the spherical rotary boilers such as are used for rag boiling, and stationary vertical cast-iron cookers. All digestors to be used for pressures over 20 lb. gage should be constructed according to the requirements of the A.S.M.E. Steam Boiler Code, be inspected regularly and preferably insured. In any case where it is desired to operate grinders continuously on steamed-wood logs, two steamers should be installed for the following reasons: First, to have one steamer in reserve in case of breakdown; second, to permit of continuous operation of the grinders by compensating for the long time needed for cooking one charge and thus keeping the grinders supplied with wood. Two cookers of either type described below will be ample to keep two three-pocket grinders supplied for a cooking period of 15 to 20 hours, which is long enough for most requirements. Finally, by using two cookers, the steam left after a cook can be utilized by blowing it down into boiler feed water before discharging the wood; whereas with only one steamer the delay involved makes it uneconomical.

Rotaries are best mounted on concrete piers and as closely together as possible to economize space and simplify the wood-conveying equipment layout. Too small foundations are false economy in this case, because, during the rotation of a boiler when filled with logs, severe and sudden stresses are set up by piles of logs clinging together during part of a revolution and suddenly becoming loosened. Fig. 1 is an elevation of a good layout for two rotary boilers showing the uncooked wood conveyors to grinders. Fig. 2 is a vertical section through the boilers and discharge pit. This arrangement is particularly adapted to installations where space is limited and the use of water canals to grinders is impracticable. It will be understood of course that canals may be substituted for the cooked-wood handling arrangement shown and vice versa.

The whole equipment occupies a space of approximately 40 by 21 by 25 ft. high. The boilers are 16 ft. in diameter and each will hold about 6 cords of rough wood or 7½ cords of peeled wood, as irregularly discharged into them from the conveyor and not as carefully packed. They are placed over the steamed-wood discharge pit and can be rotated once every 4 minutes by a vertical worm which engages a circular rack fastened around them, as shown. Lining, while desirable, is not absolutely necessary, as the small amount of corrosion is extremely slow if all rivet holes and joints are kept calked. Each cooker has a manhole about 2x3 ft. for filling, emptying and permitting interior repairs and is also provided with a small bleeding pipe and valve for removing condensate and relieving air while heating up. In common with all rotary boilers, steam enters through the hollow shaft after passing through a reducing valve.

The 2-ft. logs from the wood room are carried by a

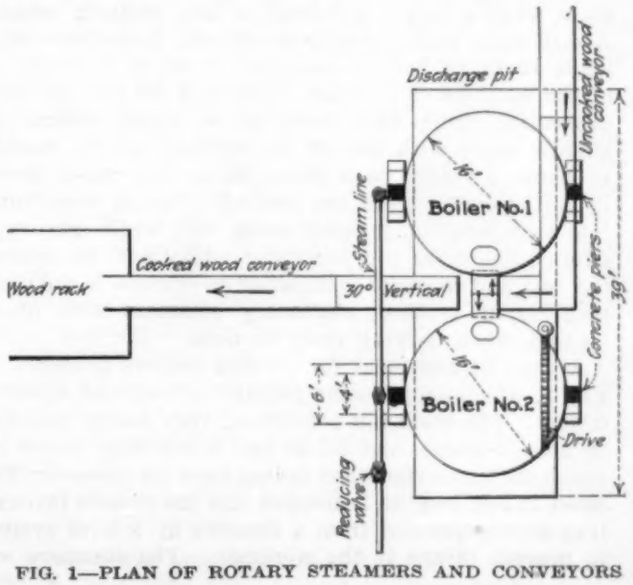


FIG. 1—PLAN OF ROTARY STEAMERS AND CONVEYORS

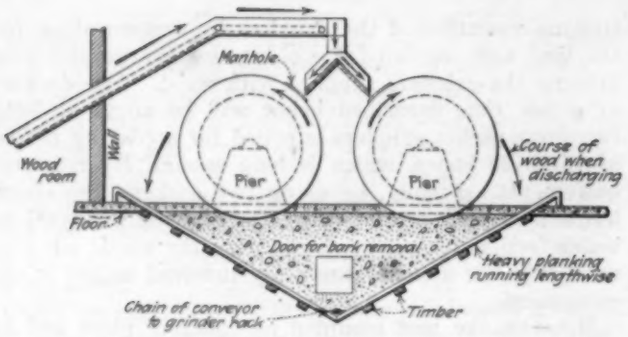


FIG. 2—VERTICAL SECTION THROUGH ROTARY STEAMERS, SHOWING CONVEYORS AND DISCHARGE PIT

chain trough conveyor at approximately a 45 deg. vertical angle to the level conveyor section over the boilers, which discharges into a chute above and between the two boilers, which in turn discharges at will into either of two smaller chutes directly into the manhole of the boiler being filled.

A Triplex block is used for handling the manhole cover, while a system of stairs and runways permits access to all parts of the filling system. Upon falling from the manhole in emptying a boiler, the wood drops into a steamed-wood discharge pit located beneath the two boilers (Fig. 2). The wood tends to roll down to the middle point, where it is put on a chain conveyor, which takes it to the grinders. This conveyor drops the wood into a wooden rack, a fenced-off portion of which is used as storage.

In general, rotary boilers have the advantage that, because of their shape and the closeness with which they may be placed together, they can be erected in some empty corner of a wood room or grinder room, as they do not require the heavy foundations and tall buildings necessary with vertical steamers. Moreover, they can be used very effectively as a drum barker, by rotating after steaming is completed, thereby softening and loosening the bark. Wood for the vertical type must be barked previously unless it is to be ground in the rough. The vertical type requires less calking and attention to keep tight and the maintenance cost is much less than with the rotary, in which the joints are loosened by the movement. The stationary type can be effectively lagged with heat-insulating material to reduce radiation and steam consumption to a minimum, while a rotary is difficult to keep properly lagged. A stationary cooker dumps practically instantaneously, while about an hour is required to empty 7 cords out of the manhole of a rotary. For this reason the daily production from two digestors of equal volume is slightly more with one of the vertical design, though by using a rotary as a drum barker the heavy losses in knife-barking wood are avoided. Taking everything into consideration, it would seem that, while each type offers advantages for particular conditions, in general the best and cheapest installation to operate is the combination of vertical, stationary steamers with drum barkers when barking must be done.

A good arrangement for vertical cookers is shown in Fig. 3, which adopts some features of sulphite digestor towers. The wood bin consists of very heavy planking on steel I-beams, and inside has heavy steel plates on which the logs strike when falling from the conveyor. The wood, in 2-ft. lengths, is dropped into the cookers through trap doors, operated from a distance by a lever system to prevent injury to the workmen. The steamers are supported, as shown, on three legs, which rest on the concrete floor of the discharge pit. This is kept filled with water, except when emptied to clean out, and connects by an underground canal to the grinder feeder canals. The bottom of the cookers is conical in shape so that all the wood will fall out when the bottom is lowered by the action of a hydraulic ram on the floor beneath, whereby a tight joint is normally maintained.

These cookers are now made of cast iron, tested for 50 lb. working pressure, and have 1½-in. walls to compensate for the slow chemical deterioration and the mechanical wear from the logs. They are made up of four cylindrical sections superimposed upon one another, and a top dome-shaped section bolted together with the proper gasket. The cost of a digestor is about $5,000.

The manhole cover is provided with a ring for handling with a chain block and is fastened down by lag bolts to the dome-shaped top section. This dome-shaped section has a boss in it which may be drilled out if desired for the insertion of a thermometer.

The log conveyor over the wood storage bin has a baffle, so arranged that it can be put in position and cause the logs to fall over the first cooker, or left open, permitting the logs to discharge over the second.

The unit log capacity of rotary and stationary digestors—i.e., the cubic feet of digestor volume required

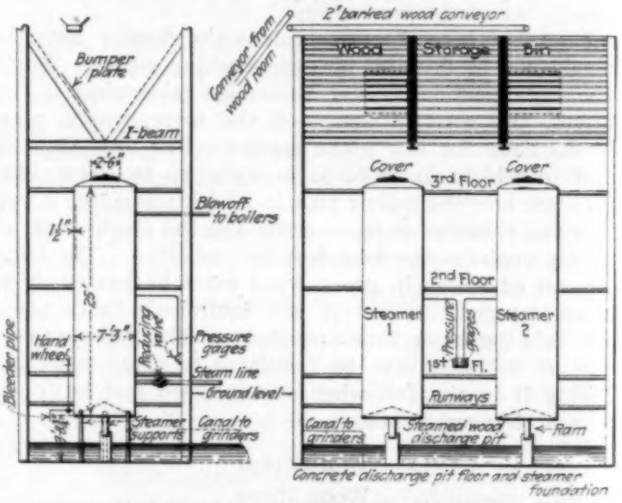


FIG. 3—VERTICAL DIGESTORS FOR STEAMING WOOD

per cord of wood as filled in by the conveyor or bin—is practically the same, hence, as regards economical utilization of the volume of the digestors and consequent economy of cooking, there is practically no difference on this score. A 16-ft. rotary has a volume of 2,145 cu.ft. and will hold 6 cords of barked wood or 7½ of peeled.

For boiling logs in water at atmospheric pressure, any container mechanically strong and tight enough can be utilized. One arrangement that has been used successfully was a wooden tank holding about 6 cords, strengthened by steel tie rods and arch-shaped wood sections. The top was also of wood and had a large square manhole. The steam inlet was at the bottom, while the wood was put in and taken out by hand through the manhole.

GRINDERS, SCREENS, PUMPS, WET MACHINES

Some mills make no provision for corrosion during and after grinding, although it is more severe than dur-

ing the cooking, owing to the soluble matter and acids remaining in the logs. The best modern practice is to have all the grinder pockets lined with bronze and to use solid bronze centrifugal pumps, screen plates and wet machine cylinder mold wires. Piping is also preferably of this material, but wood is used with success. Cast-iron valves and fittings have been used, but these corrode considerably.

Because of the slowness of the pulp and its greater fiber length—more on the order of sulphite than the untreated news ground wood—coarser screen plates are required or greater screening surface with finer slots.

Beaters, Jordans

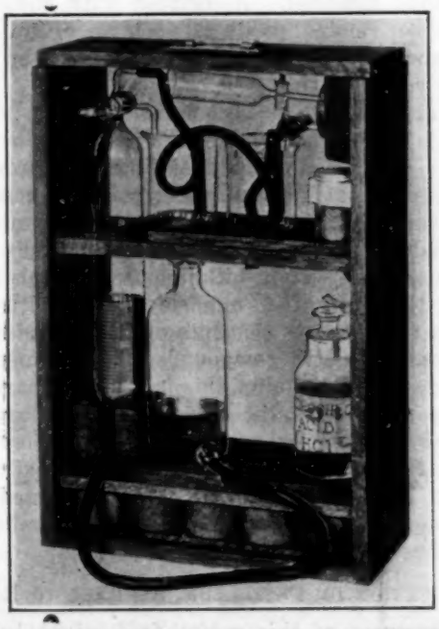
By the time the stock reaches the beaters or mixing tanks and jordans, every trace of acid is washed out so that any standard equipment can be used without modification, bearing in mind that, in common with natural or untreated ground wood, beating cannot materially change it, except to shorten the fibers, once it is ground.

The concluding installment of this article, describing the operation of a modern plant for steamed ground wood, will be published in a subsequent issue.

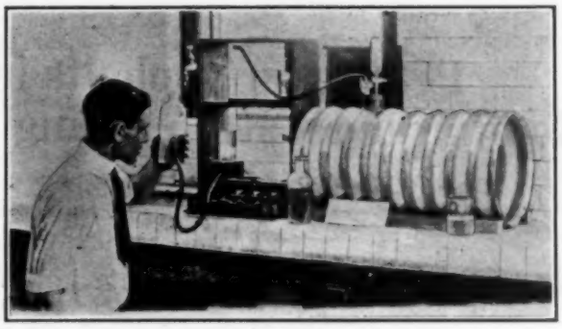
A Testing Device for Weighing Galvanized Coatings

IN PURCHASING galvanized sheet metal and wire for manufacturing various products, the manufacturer's specifications include the weight of spelter coating in ounces per sq.ft. An interesting device for measuring this spelter has been developed recently and may be used in the laboratory as well as in the field. The device determines the weight of galvanized coating on a unit area regardless of any convolutions or corrugations.

The weight determination is based on the action of hydrochloric acid on the galvanized coating, collecting and measuring the hydrogen gas evolved. By using differently shaped rings, which are shaped to fit the surface to be tested, the weight of coating is determined on flat sheets or formed culverts. Wire coating is determined by placing a definite length of wire on a glass plate under the flat ring. The rings are made to resist acid, nickel or tinned iron being used. The rings are fitted with three-hole stoppers. One hole carries the filling tube provided with a glass stopcock, while the other holes carry exit tubes. For collecting and measuring the hydrogen evolved, a measuring burette and leveling bottle are used.



THE TESTING DEVICE PACKED IN ITS CASE



THE APPARATUS IN USE

How the Determination Is Made

To make a determination the proper ring is sealed to the surface to be tested with acid-resistant cement. The leveling bottle, glass burette, tubes and ring are filled with water by manipulating the leveling bottle and stopcock. About 30 c.c. of concentrated hydrochloric acid is then placed in the filling tube and about 5 c.c. admitted to the ring. When the liberation of gas ceases the apparatus is rid of gas by filling the ring and connecting tube with water, thus forcing all the gas into the burette.

The number of cubic centimeters of hydrogen measured at 20 deg. C. multiplied by the factor provided with each ring gives the ounces of spelter coating per sq.ft. of actual surface on one side of the culvert.

Improved Heroult Furnace

A 7-ton basic Heroult furnace has been installed by the American Bridge Co. in the International Nickel Co.'s new plant at Huntington, W. Va., to melt Monel metal.[1] It has a round shell and flat bottom—a combination of great structural strength. It tilts both front and back on rockers; both rocker and track are curved. This does away with the counterweights necessary for the hinged type, it permits the furnace to be set lower than though the track was curved, and the center of gravity can never go above the rolling center.

Large copper pipes act as current conductors. Since this form is the best for carrying alternating current, and permits of water cooling, the amount of copper necessary is reduced two-thirds. Cooling water passes through the transformer, then by the conductor pipes to the electrode holders, through flexible connectors to electrode coolers, and thence to waste. Another unique feature is the placement of the electrical apparatus in a room immediately under the furnace.

The three electrodes are held by stiff cantilever jib cranes whose masts are quite short and operate in guides attached to the side of the furnace shell. In general, the design is very compact, requiring the minimum of headroom.

Furthermore, there are no flexible cables obstructing the surroundings.

[1] The *Iron Age*, Aug. 10, 1922, p. 342.

Petroleum Asphalts in the Roofing and Waterproofing Industries

Development of the Use of Petroleum Asphalts in Roofing and Waterproofing Industries—How This Material Is Used in Making the Various Types of Commercial Product Is Described

By Dozier Finley
Director of Technical Research, The Paraffine Companies, Inc.

IT IS IMPOSSIBLE for this topic to be treated properly from the point of view of the experience of any one person who is connected with the roofing and waterproofing industries. The history of these industries spans more years than are comprehended in the active business or professional life of any individual. However, the existence of some of the companies operating in this field extends back so far they may be said to have been present at practically the birth of the industry; their records afford valuable data on the subject.

Development and research in waterproofing and roofing manufacture lie largely in the selection and combining of ingredients and components and in the seeking for and development of new raw materials.

Development Through Use of Coal Tar

As the industries existed prior to 1885 most of the work revolved around the use of coal tar. For roof work it was found that certain coal tars were adapted to the laying of comparatively flat roofs; one or more layers of paper or felt were applied to the roof by means of pitch produced by a partial distillation of the coal tar; a surfacing of the tar pitch was given to the paper layers and into this surfacing was sprinkled gravel, shells or similar granular material. Much of the tar was not satisfactory for such roof work and various devices for improving its quality were practiced, as, for instance, heating it with lime or with wood or coal ashes.

Admixtures with a large range of other materials were tried and even used to a considerable extent; for such blendings were used rosin, pine tar, tallow, "pitch," asphaltum, dead oil and, in fact, anything which showed any tendency to mix with the tar when cold or when heated. Aside from tar, fabrics saturated with linseed oil, with other oils or with oils and gums combined, were proposed for roofing. Many roofing mixtures were designed to be spread like mastic without the support of a paper or fabric, apparently with the childlike faith that the elasticitiy of the coating so formed would respond to every movement of expansion and contraction on the part of the sheathing boards.

Failings of Early Products

Viewed in the light of present-day knowledge, the things which the inventors and manufacturers before the early '80s did not attain were:

1. The manufacture of standardized bituminous roofing and waterproofing materials in large quantities.
2. The manufacture of prepared or ready-to-lay roofing in a form and weight convenient for marketing, with a substantial weather-resisting coating and adapted to being laid on flat areas, on slopes and even on vertical surfaces, and possible of use under any condition of climate from torrid to frigid.
3. The manufacture of bituminous roofing materials of attractive appearance to compare in artistic value to slate, shingles or tile.

Along with this, of course, was a lack of proper mechanical appliances to manufacture roofing and waterproofing materials in the vast quantities used today. This, naturally, is not strange, since growth in any industry brings with it the development of machinery of greater capacity and lower unit cost of operation.

Generally speaking, the development of these industries has been seemingly slow; this may be ascribed to two reasons: First, the tardy discovery and slow recognition of suitable raw materials; and secondly, the inability to predict accurately the durability of any particular combination of materials; a new or improved product has had to pass through a long period of service test before the manufacturer, the dealer and the consumer, each in turn, have been convinced of its merit.

It is true that some opposition has been brought to bear on these industries. Metal roofings, shingles, slate and tile have been in competition with bituminous roofing. Soap compounds mixed with concrete, surface treatment of masonry walls, and structural devices have been used instead of bituminous waterproofing and methods. The engineering world and the general user, however, have always given due recognition to the merit of the bituminous products. As a result these materials have established a definite and not unimportant place for themselves in modern building and engineering.

What Bituminous Roofing and Waterproofing Are

Strictly speaking, the term "bituminous roofing" is limited to the well-known types of ready-to-lay roofings either in roll or shingle form and to built-up roofs of several plies of roofing felt cemented together with bituminous material. Associated with these roofings are certain related products such as bituminous roof paints and bituminous plastic compounds used for maintaining roofs of this type.

"Waterproofing" is accomplished by a variety of materials and methods. Layers of felt may be cemented together to form a water-resisting dam or membrane not dissimilar to a built-up roof; paints or combinations of paint and coatings of bituminous compounds applied in heated condition are often used on walls or under floors to exclude water; bituminous materials have been used in the form of an emulsion mixed with concrete; between the separate elements of large structures, such as dams, asphaltic compounds are often poured in masses; a modification of this last use, in part a waterproofing method, is the use of asphalts or asphaltic materials for the expansion joints of concrete highways; a limited type of waterproofing, really a dampproofing, is accomplished by using saturated felts, or saturated and coated papers, between the walls of buildings—the so-called "building papers."

Application of Petroleum Asphalt to Roofings

A retrospect of this entire field might be expected to reveal a single definite "line of descent" along which

all development proceeded. Following closely the commercial and manufacturing history of the industry, it is an impressive fact that its growth has held absolute pace with the advance made in the production of petroleum asphalts. A certain production of roofing may be claimed to have followed the increased output of "natural" asphalts, and it is true, without question, a large development of coal-tar roofing materials has accompanied the growth of the coke-oven industry and the more careful collection and marketing of gas tars. But it remains a fact that the constantly growing production of the most widely adopted types of roofing has been in strict correspondence with the production, for general purposes, of residual asphalt from the distillation and treatment of petroleum.

The first commercial productions of asphalt from petroleum were from California oils, which yielded asphalt as a normal product of distillation. Asphalt from the oils of Pennsylvania, Ohio and Indiana was practically unknown until well into the twentieth century; then it was produced by methods of treatment apparently unknown to the earlier refiners—it was produced by what might be termed abnormal processes rather than the old, and previously well-known, methods of distillation.

The first application of California asphalt to the manufacture of ready-to-lay roofings was made by Truman J. Pearce and Melvin W. Beardsley as set forth in the patent granted them Sept. 14, 1886. From a historical point of view it is unfortunate Pearce and Beardsley did not more specifically state in their application that they preferred to use a "maltha" which was the residue of petroleum distillation. However, at the time their work was in progress many "natural" asphalts containing much mineral matter were obtainable in California. To these early inventors it seemed possible to use these interchangably with asphalt produced from petroleum. Indeed, the apparently limited possibilities of the then known petroleum territory in California and the seemingly extensive natural asphalt deposits possibly inclined them to the use of the natural product.

But, as might be expected, when asphalt from petroleum distillation outstripped the quarried material, Pearce and Beardsley, or rather the Paraffine Paint Co., which manufactured under their patents, fixed on the material which could be obtained in larger quantity and of more uniform quality and greater purity.

Work of Pearce and Beardsley

Pearce and Beardsley employed the residual asphalt as a saturant for burlap which then was given a further coating of a firmer asphalt; to the back of the coated fabric, while the coating was hot and adhesive, was affixed a layer of paper or felt to give the roofing stiffness during handling and shipment and also to afford additional waterproofness. Probably this was the first distinctly successful ready-to-lay roofing which had been produced. It established records of service reaching well beyond 20 years, in many instances with the material exposed on slopes so steep as to draw forth a dogmatic "it can't be done" from the roofers of that day. It became a practice to supply this roofing without change of formula to the coldest climates of the North and to the hottest parts of Arizona and Mexico. No limits were placed on the angle of the slope to be covered, no matter what the sun heat might be.

Large quantities of the roofing were readily sold to the smelter plants in Arizona and Montana—two extremes of climate, but in both involving an exposure to acid fumes so corrosive that the paint and the very nails were eaten from the boarding of the buildings. The service rendered by the roofing under such conditions is well illustrated by a letter received over 20 years ago from the United Verde Copper Co., Jerome, Ariz., telling of a sagged portion of roof on which condensed exhaust steam, flue dust and dissolved fumes had combined into a little lake of highly concentrated acidity; though this condition had obtained over a period of several years, the roofing had not leaked a single drop. One of the most successful large pieces of work carried out with roofing made according to this plan was the covering of the entire Midwinter Exposition at San Francisco in 1893-4.

Substitutes for California Petroleum Asphalt

So successful was the roofing made from California petroleum asphalts that the Standard Paint Co. of New York, under the instructions of Beardsley, began the manufacture of similar roofing in the East. Petroleum residuum of quality similar to California asphalt was not obtainable in the East and it was necessary to bring material from the Pacific coast. However, William Griscom, of the Standard Paint Co., hit on the scheme of using the residual products of Eastern petroleums in conjunction with very thick sheets of felts. In this way a very large portion of Eastern residuum tempered with rosin could be used as a saturant; the saturated sheet was given a coating which consisted of a California asphalt blended with a large measure of weather-resisting gums and pitches.

Thus was produced in the East the first successful, standardized, ready-to-lay roofing made in large part from Eastern materials. It came almost at once into great popularity, which it retains to the present day. Its name, "Ruberoid," was caught up by the public and applied as a type name to all ready-to-lay roofings regardless of the manufacturer's name or any other relationship to the original in manufacture, formula or even appearance.

It is now recognized that the materials which are best adapted to the manufacture of ready-to-lay roofings must conform in a great measure to the standards established by the early work of Pearce and Beardsley in California. Of course the developments which have taken place in the last 20 years in the processes of oil refining and asphalt making have been reflected in the improved quality of the asphalts and the products made from them; the roofings made today will withstand conditions of exposure which would not have been possible for roofing made from the original petroleum asphalts, though this does not gainsay the very excellent quality of the roof coverings made with the earlier types of California asphalts.

The oils of Ohio and Indiana, and later the oils of Kansas and successively those of Texas, Oklahoma and Mexico, have been made to yield asphalt. Originally oils such as those from Ohio were supposed to be incapable of giving asphalt in the refining process. In those days refining consisted essentially of heating the oil in closed containers, or stills, and thereby driving off the volatile portions, the temperature being gradually raised till the distillate had attained a high boiling point and the residue in the still had been reduced to a coke, or, in the case of asphalt-yielding oils, to an asphalt of the desired hardness. Steam was admitted

at the latter part of the distillation to reduce the vapor pressure or, in the language of the stillman, "to carry the vapor over."

Obtaining Asphalt From Paraffine Base Oil

F. X. Byerley obtained a patent in 1894 for a process of asphalt proluction which accomplished two things: first, the production of an asphalt from oil and oil residuum which would not yield asphalt under former methods of refining; and secondly, the production of much higher yields of asphalt from oil or residuum which normally yields asphalt. The process is carried out by blowing air through the petroleum residuum at elevated temperatures and is conducted in the ordinary still; a reduced amount of distillate is produced, the greater part of the residuum being converted into asphalt through complex chemical reactions, among which there is certainly an oxidation, as hydrogen is eliminated with the formation of water which appears in the distillate. If the process can be regarded as accomplishing, in a measure, the equivalent oxidation which would otherwise be brought about through a term of weathering, it will be seen that the asphalt oxidized in the still, and refined to the proper consistency for use, has conferred on it something of an immunity from the destructive action of continued oxidation when exposed to the weather.

Many modifications of the original process have been brought about, so that it is now possible not alone to produce asphalt from a nominally non-asphaltic oil and to increase the yield of asphalt from asphaltic oils, but it is even possible for the skilled refiner to make a series of asphalts of widely varying characteristics, though of substantially the same "hardness," from a single crude oil or oil residuum. This contrasts strongly with the possibilities of the old, or "steam run," process, wherein there was practically no control of the character of the product, aside from its "hardness."

The production of standardized asphalts from these widely differing oils is indeed a testimonial to the ability of the refiner. From each of the sources named now comes asphalt which would admirably do the work of the original Pearce and Beardsley process. The California asphalt, at one time alone in filling these requirements, has been improved, as might be expected, by the research work of some of its producers to a point of excellency never conceived by those who first used it in roofings.

Manufacture of Roofing and Waterproofing

The standardization of roofings and waterproofings has really preceded the standardization of the asphalt. At the present day roofing materials are almost exclusively built on a felt base, the burlap base being used in an extremely small volume, relatively speaking. The felt falls into three classes: *rag felt*, composed entirely, or almost entirely, of cotton rags, with a small percentage of wool and usually a small amount of burlap; *asbestos felt*, or paper, composed almost entirely of asbestos fiber with a minor percentage of other fiber and a sizing binder to give strength; and *paper based felt*, used entirely in the cheap grades of roofings and sheathings, containing as high as 70 per cent of waste paper.

The materials entering into the composition of these felts are disintegrated in paper mill beating engines until the ultimate fibers are individually afloat in water, the mass is passed on to a type of paper-making machine adapted to the work; the fibers are here felted, pressed and dried. The finished felt, in large rolls, is transferred to the roofing-making machine; here it is passed through a bath of saturant, squeezed by wringing rolls to remove the excess of saturant, and pressed through another set of rolls which spread on it a bituminous coating of varying thickness according to the purpose intended. Either a dusting of a fine mineral powder is now given the product, making the so-called "smooth surface roofing," or a sprinkling of crushed shale or slate of usually a red or green color is applied to the side designed to be exposed to the weather, making a "slate roofing." This in only "slate" in so far as it is surfaced with a thin layer of mineral particles, which may even be marble or serpentine in some instances; but these particles, no larger than a match head, are so firmly fixed in the bituminous coating that the roofing will last upward of 20 years without apparent deterioration.

Smooth surface roofing is sold in roll form only. The slate roofing may be sold either in roll form or cut into shingles, which again are divided into "individual shingles" and "strip shingles," the latter usually comprising four shingles attached together by a common upper portion. Variant forms of these roofings are sold, as for instance a sand-surfaced roofing, or a mica-surfaced roofing, but their use is secondary, though this does not argue against their quality, which may be excellent if they are made of good materials.

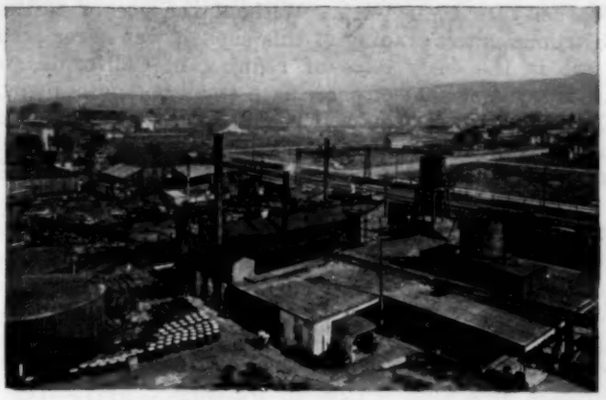
Asbestos Roofings

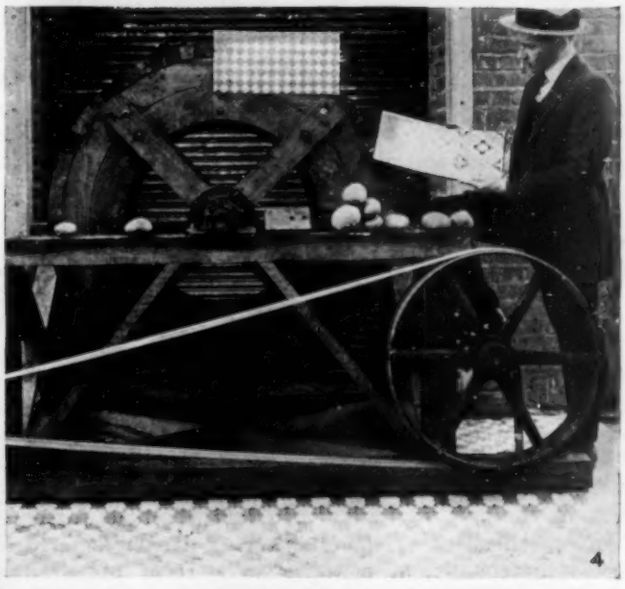
Asbestos roofings usually are made by cementing together two or more sheets of asphalt-saturated asbestos felt or paper. This may be done in the plant and the product shipped ready to lay; in this event the topmost sheet is often unsaturated, which is productive of a white roof. On the other hand, saturated sheets may be supplied to the contractor and applied by him in a manner similar to "built up" roofs, though asbestos roofs are rarely given a gravel or mineral dressing.

Asphalt-saturated rag felts of various weights are supplied to roofing contractors for laying "asphalt and gravel" roofs. The saturated sheets are cemented together on the roof deck, the topmost sheet receiving a flood coat of the bituminous cementing compound; gravel, crushed slag, crushed brick or other desirable or readily obtainable mineral matter of pea size is imbedded in this flood coat to procure a final finish. Using the proper quality of cementing asphalt, such roofs may be applied on slopes so steep the workmen have to be secured by ropes. In this respect, at least, asphalt-saturated felt cemented by asphalt has an advantage over tar-saturated felt and coal-tar pitch; excellent though "tar roofs" are on flat and slightly sloping roof decks, they cannot compete with asphalt on steep slopes.

Many roofers use, and some manufacturers advocate, one or more layers of smooth surface roofing to be built into a roof of the "asphalt and gravel" type. One sheet of medium weight smooth surface roofing can take the place of two sheets of the heavier grade of asphalt-saturated felt. As a better and stronger felt with a greater percentage of saturation is used in the smooth surface roofing, the resultant roof naturally has an enhanced value. Gravel or like matter is usually used as final finish as on the parent type of roof.

It is interesting to note the built-up roof of asphalt-saturated rag felt, or roofing, as above described, has a





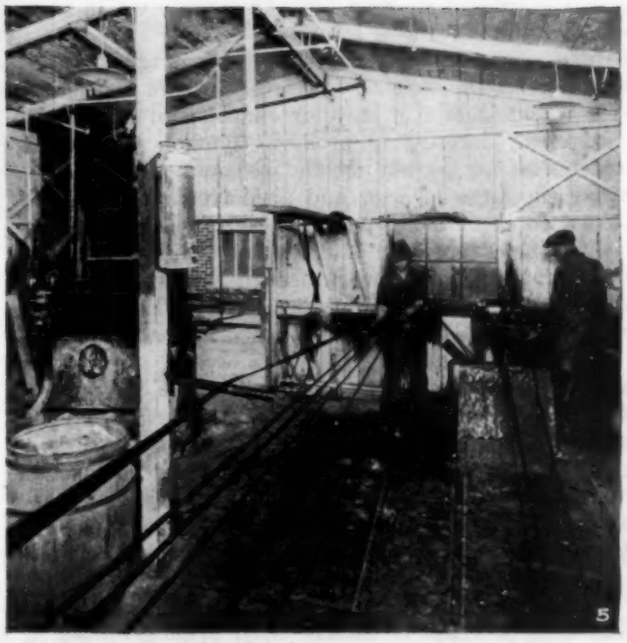


Fig. 1—California Refinery for Production of Petroleum Asphalt

Fig. 2—Test Rack for Weathering Tests on Petroleum Asphalt Paints

Fig. 3—Concrete Tower for Testing Concrete Waterproofing Material

Fig. 4—Revolving Drum in Which Pebbles and Bits of Steel Are Used to Test Wearing Qualities of Petroleum Asphalt Floor Coverings

Fig. 5—Mechanical Manufacture of Insulating Tape Using a Water- and Weather proofing Petroleum Asphalt Compound

degree of fire resistance which places it on an equal basis with asphalt-saturated asbestos roofings.

Asphalt in Waterproofing

The standardization of roofing materials did much to standardize asphaltic waterproofing. The asphalt felt of the roofing industry became the basis for felt for building membranes of several felt layers around the walls and in the floor of the structure to be protected from the entry or exit of water. Modifications have been made as, for instance, the surfacing of the waterproofing fabric with wood flour instead of fine mineral matter in the case of coated fabrics—a change made to obtain better adhesion of the cementing medium.

Asphaltic building papers of three types were developed along with the several types of roofings; these were: paper saturated with asphalt, paper coated with asphalt and paper both saturated and coated. Such papers were designed to prevent entry of moisture and drafts through walls and floors of buildings. Both asphaltic roofings and these buildings papers were made, generally speaking, by the same manufacturers; indeed, in small plants, often on the same machine. To the three above is now added a light saturated felt. The four types are standard with many manufacturers and may be obtained at retail in almost any town in this country in a variety of weights and qualities at, of course, prices in accord with their respective values. They are all superior to that cheapest form of so-called "building paper" known as "rosin-sized sheathing" of a red, gray or greenish color and made of the cheapest grade of waste paper, reworked and waterproofed more by title than in fact.

Asphalt in Paints

Bituminous paints and compounds to be applied in molten condition for damp-proofing and waterproofing have come to the distinctive position of having been the subject of tentative specifications by the American Society for Testing Materials. Treatment of expansion joints in concrete highways also is subject to fairly definite specification by the engineering departments in charge; materials and methods vary from prepared products marketed in strip form to asphalt which may be poured into the open joint.

Bituminous emulsions for waterproofing concrete have been on the market for several years. In general it would seem that a water emulsion of asphalt is an extremely interesting product—emulsification with water makes an asphalt mobile without application of heat at the time of use, and also avoids the hazard attached to bituminous paint with volatile, flammable solvents; the evaporation of the water, which takes only a short time, brings about a breaking of the emulsion and a deposit of the asphalt in a form little different from that obtained through the use of an actual solvent or through hot application.

In waterproofing, where exposure to the weather is not involved, where the waterproofing material may be below grade (and hence at a fairly uniform temperature) and where there may be little vibration of the structure, coal tar is a strong rival of asphalt. The coal tar, of course, is used in conjunction with a tar-saturated felt when the work involves the use of felt.

Grades of Asphalt Used

The type or grade of asphalt most generally used in all this work takes its origin from the old California "D" grade, this was the grade used by Pearce and Beardsley in their work. Without the use of testing instruments the grading of this asphalt was never accurate; in the early days of refining in California the usual test was that of chewing a small portion. Pearce and Beardsley used in their roofing a "D" asphalt which offered considerable resistance to chewing but which would not crumble in the mouth. Samples of this examined since the advent of testing instruments and standard testing methods give a penetration of about 15 at 77 deg. F. and a melting point—i.e., softening point—of about 150 deg. F., both by the methods of the American Society for Testing Materials, standards 1921.

Improvements in refining now permit of the use of asphalts somewhat softer at ordinary temperatures—they offer little resistance to chewing. The penetration will range from 12 to possibly 45 according to the properties of the material itself, as defined by source and preparation, with melting points from 150 to 225 deg. F. or occasionally higher. Most manufacturers of roofings set narrow limits between which their compounds must test—these, except for saturants, are between the limits here given in practically every case. Many manufacturers of roofings also blend the asphalt with fatty acid pitches, natural asphalts, mineral fillers, etc., to obtain increased weather resistance, to economize in the use of asphalt or for other reasons of minor importance.

Of course other tests than melting point and penetration are applied to asphalts. These include volatility, hardening under heat, ductility, ash, solubility in carbon bisulphide, penetration at other temperatures than 77 deg. F., flash point and others less frequently applied.

How Other Grades May Be Utilized

Nor can it be considered that asphalts falling within the ranges above given will accomplish all the things set forth in this article. Asphalts within those ranges form, as it were, the backbone of the asphaltic roofing and waterproofing industries, but much of the work herein described would have to be accomplished through the fluxing, or softening, of an asphalt falling within the above given range, an operation easy of accomplishment. Softer asphalts ranging down even to a stiff, practically liquid material are to be had on the market. These are used for saturants for felts or for fluxing harder grades.

Hard asphalts—so hard they will be powdered in the chewing test—are necessary for other work; while their melting points may not be materially higher than the highest of the medium hard asphalts, their penetration may be as low as 2. They are used in paint making, in the glaze coating of building papers and may be used in compounding roofing coatings to counteract the effect of softer constituents such as soft fatty acid pitches, soft asphalts, etc. It is of interest to note Pearce and Beardsley prior to 1890 used "B" and "C" California asphalt for the making of "P & B" paint and "P & B" building paper—the "B" and "C" asphalts having penetrations of about 3 and 8 and melting points of about 195 deg. F. and 175 deg. F., respectively.

Place of Natural Asphalts and Coal Tar

It would be unfair for the asphaltic roofing and waterproofing industries to fail to acknowledge the immense value of the contributions which have been made to them from the field of mined asphalts. Without question the industries started with those asphalts as

their only raw materials of asphaltic nature, and have used large quantities down to the present date—gilsonite, grahamite and wurtzilite, in addition to the true native asphalt of the medium grade of hardness and associated very often with large percentages of mineral matter. Also these industries owe much to the coal-tar industry, which has been a helpful rather than a harmful rival, and to the asphalt-paving industry, which has been untiring in the development of new sources of raw material and has contributed much scientific data to the entire subject.

The amount of asphalt this country consumes in roofing and waterproofing is not easy to estimate, as it is difficult to separate it from the figures giving total importation and production. It is not amiss to say, however, that the amount has grown in the last 30 years from a few hundred tons per year to well over a quarter of a million tons.

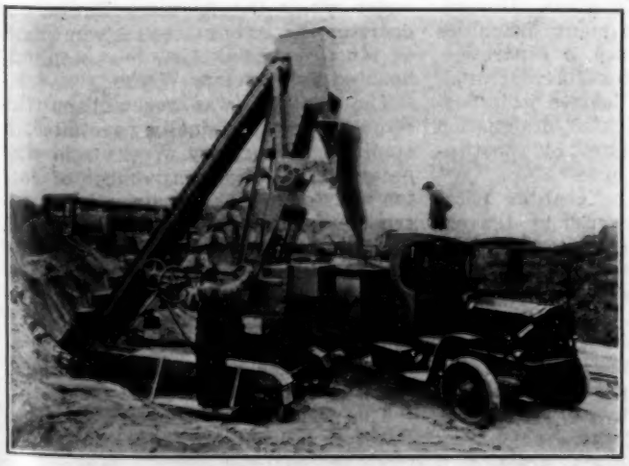
A New Portable Loader

In many plants where it is necessary to handle sand, gravel, crushed stone, coal, coke, cinders, slag and other loose material from ground storage, the portable loader has found wide use. This extended use and the interest shown by many who do not as yet use this machine has been the cause of bringing forward many improved types during the last few years. The latest of these, shown in the accompanying illustration, is called the "Tanktred" and is manufactured by the Jeffrey Manufacturing Co., of Columbus, Ohio.

Among the advantages claimed for this loader attention is called to the fact that the foot of the elevator is so constructed that the buckets are wider than any other part, so that the whole machine can be advanced several feet into the pile with nothing but the clean cutting edge of the buckets coming in contact with the material. For this reason the loader will handle fairly hard material which will not flow.

Another advantage claimed for this loader is a relatively large foot wheel, which, by reducing the centrifugal force, enables the buckets to pick up the material and especially the large lumps without kicking them away. A flexible wood boom keeps the buckets digging, but will spring enough to release them from overload strain when they encounter a cave-in or an obstruction.

Two speeds, a traveling speed for moving the machine from place to place, and a feeding speed for driving the machine directly into the pile, give a wide flexibility of operation.



NEW PORTABLE LOADER

As a result of these various features of design and construction the operator, the only man required in connection with the operation of the loader, can readily manage his machine so that the buckets are always full.

Hair Cracks

During the war many alloy steel forgings were discarded because of "hair cracks" (Fig. 1) usually about $\frac{1}{2}$ to $\frac{3}{4}$ in. long, a few thousandths deep and almost zero thickness. They are rarely found singly, and if machined off by a fine cut, more will usually be found in new positions.

Dr. Leslie Aitchison[1] believes that they are relics of very small contraction cavities in the original ingot.

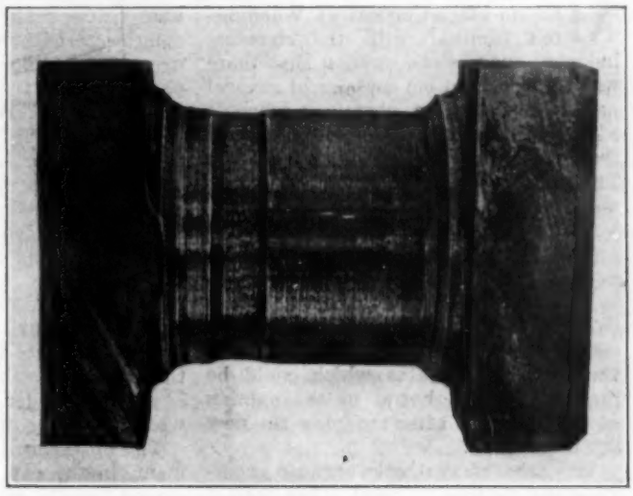


FIG. 1. HAIR CRACKS APPEARING AS HORIZONTAL FINE WHITE LINES IN CENTER OF PARTLY FINISHED CRANKSHAFT JOURNAL

Correct forgings welds these up to some extent, but the utmost care should be exercised during steel making and ingot pouring to reduce the number of contraction cavities to a minimum. Also, the part of the ingot which shows the defect most markedly should be cropped.

While it is impossible to say whether these tiny flaws are harmful to such a thing as an airplane crankshaft, "it is fairly certain that they are practically harmless unless they occur in very vital parts. It is quite certain, owing to the difficulty of detecting the cracks, that a large number of cranks have been used in which they have existed and that no trouble has resulted."

Rubber Manufacturing Industry in Egypt

The Société des Industries Egyptiennes, Sahel El Ghelal, Boulac, Cairo, operates a factory for the manufacture of rubber goods. This factory started operations as a private concern about 11 years ago. Raw rubber and other materials are imported from England and Belgium, and a small quantity from France. Of late years the Sudan has been able to supply a small quantity of plantation rubber, there being 40 acres planted. The company sells mainly to the Egyptian Government departments, but also to private dealers; and in addition to selling wholesale, it accepts retail orders. It is claimed that the products are successfully competing with foreign manufactured rubber goods.

[1]Quoted by C. F. Jenkin on p. 22, "Report on Materials of Construction Used in Aircraft and Aircraft Engines," Aëronautical Research Committee, London.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Flaws in Chemical Schedule Crop Out

Officials Encounter Difficulties in Applying Rates, Particularly in Case of Dyes

MEN in official circles of Washington familiar with the chemical industry express the opinion that there will be, or should be, revision of several paragraphs of the chemical schedule of the new tariff act. It is also believed that the Customs Division of the Treasury Department will have to set up rather elaborate machinery, at considerable expense, to administer properly the duties on coal-tar products, particularly dyes. Some of the rates are entirely inadequate, if the domestic industry is to be given protection sufficient to encourage its development, and there are other rates which could be lowered without harm, in the opinion of these officials after studying the new act thoroughly.

The case of synthetic organic chemicals and medicinals from other than a coal-tar base has been cited previously as one where development probably will be retarded unless higher rates are granted. The duty in the new law is 25 per cent ad valorem. Several acids and salts of large consumption are among those which it is believed should have higher protection and may receive it under the flexible tariff section when that is put into operation.

On the other hand, it is pointed out that several of the common coal-tar dyes do not require the protection of 7 cents per pound and 60 per cent ad valorem, American selling price, given by the new act, while other higher priced dyes need greater protection.

Difficulty of Comparing Dyes

In adminstering the coal-tar rates, the difficulties of determining whether an imported dye is comparable to an American product are pointed out in official circles. It has been suggested that the Customs Division will require the services of an expert chemist, with several assistants and a first-class laboratory, and this is being considered by Ernest W. Camp, chief of the division.

One of the difficulties foreseen is the case of an imported dye which may be comparable to an American product for some purposes and not for others. For instance, a case arose during existence of the dye and chemical control act where two blues, domestic and imported, produced substantially the same results excepting in one instance, the imported blue being fast to salt, whereas the domestic product was not. For ordinary dress goods the two dyes were comparable, one as good as the other, but if a manufacturer wished to use the dye in a bathing suit he would have to take the imported product. The question to be decided is if, in such instances, all the imported dye is to be assessed on the basis of American selling price, as a comparable product, if all shall be considered as non-competitive and assessed on United States value, or if part shall be assessed one way and part another, according to the use for which it is intended by the consumer under special regulations which might be drawn.

The difference in the basis of assessment, in the case of dyes heavily consumed, would run into the thousands of dollars a year. It is realized that these questions involve technical tests of many products and that customs regulations must be drawn carefully.

Other Imperfections

What is to be done to give greater protection to the coal-tar products of higher grade has not developed beyond the report that a bill for this purpose will be introduced at the next session of Congress. There are difficulties of drafting a measure which would meet the favorable consideration of Congress. If the higher products are to be given greater protection, there must be a separation of the paragraph, because admittedly some of the products do not need the rate already given. Government experts foresee many difficulties of phraseology in such a separation, with different rates for different products. However, they believe it is possible by a combination of designation by name and designation by constitution, application and price.

Another flaw in the coal-tar paragraph has been discovered by the experts in the clause providing that assessments shall be on the basis of strength in ordinary commercial use prior to July 1, 1914. Since then some strengths have been changed and others have not, so that the effect of the application of this provision gives a high concealed protection to some products and denies it to others which may need it equally as much, creating a badly balanced rate.

Rapid Development of French Water Power

Hydro-Electric Power Developed More Than Doubled Since 1913

French public sentiment is strong for the utilization of water power to overcome the dependence upon foreign imports of coal. The extent of this interest is shown by the fact that in 1913 only 930,000 hp. was generated by water, while in 1921 the total of 2,100,000 hp. of hydro-electric energy was being produced.

Important individual projects include the Rhone development, which has the navigation and irrigation phases as well as its power feature; the project for harnessing the hydro-electric forces of the River Dordogne, involving seven generating plants; the world's largest dam at Chambon, and other miscellaneous projects such as those of the Rivers Ossau and Aspe.

The use of hydro-electric power in connection with the electrochemical and electrometallurgical industries of the Isere Department is important where the production of such ferro-alloys as ferromanganese, ferrosilicon, ferro-uranium and spiegel give promise to large development. It is expected that the ferro-alloy output of France will be largely accomplished by electric furnaces within a few years.

Of a total of 2,100,000 hp. of electrical energy at present used, 650,000 hp. is for lighting, heating and minor motor force, 1,300,000 hp. for industrial use and 50,000 for traction purposes.

Power Company's Lease of Muscle Shoals Renewed

Renewal for another year of the lease under which the Alabama Power Co. operates the government's steam plant at Muscle Shoals, Ala., has been announced by Secretary Weeks.

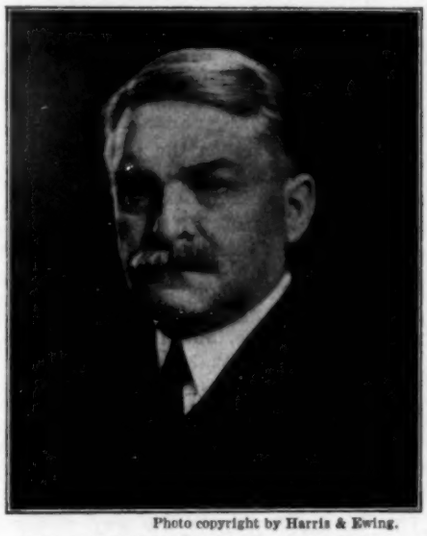
The contract was renewed on the same terms as originally negotiated, a step which Secretary Weeks said was necessary to "enable a number of cotton mills and other industries in Southern states, including North and South Carolina, to continue operations, and which otherwise would have been compelled to close down or materially curtail production because of disturbed conditions in the coal and transportation industries and lack of developed hydro-electric power."

This renewal has no bearing on the Ford or other offers for the plant, since the contract may be canceled on 30 days' notice.

S. W. Stratton Chosen Head of M.I.T.

Director of Bureau of Standards Accepts Presidency of Institute of Technology—Hoover Regrets Inability to Hold Men With Government

DR. SAMUEL WESLEY STRATTON, for 21 years director of the Bureau of Standards of the Department of Commerce, has resigned to become president of the Massachusetts Institute of Technology. The Institute has been without an executive since the death of Dr. Richard C. MacLaurin in January, 1920. Dr. Ernest Fox Nichols was elected president in 1921, but was forced by ill-health to resign a few months later without having served in office. A committee of faculty and corporation members has carried on the administrative work.



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DR. SAMUEL WESLEY STRATTON

Government Can't Hold Best Men

In connection with Dr. Stratton's resignation, Secretary Hoover issued a statement condemning the "desperately poor pay allowed scientific and technical men by the government." He pointed out that the Massachusetts Institute of Technology, an educational institution, has no difficulty in paying men of Dr. Stratton's caliber three times the salary which the government allows them. "The inability of scientific men in the government to support themselves and their families properly under the living conditions in Washington," said Secretary Hoover in his statement, "and to make provision for old age, makes it impossible for any responsible department head to secure such men for public service at government salaries."

Built Organization

As the director of the Bureau of Standards, Dr. Stratton built up an institution. He took over the directorship of the bureau when it was created in 1901. The bureau sprang from a division in the Coast and Geodetic Survey concerned with the standardization of weights and measures. During the first year of its existence the bureau was intrusted with the expenditure of an appropriation of $200,000. From that small beginning Dr. Stratton was able to built up a great scientific laboratory which has been intrusted with the expenditure of more than $2,000,000 on a year's work. Under Dr. Stratton's direction, the bureau has grown until it is the largest physical laboratory in the world and employs more specialists in research than any other single agency in this or any other country.

Those who have worked for many years with Dr. Stratton declare his strongest point is his ability to direct the work on a large number of diversified technical problems in a way so as to insure maximum results. Despite the widely varying character of the experimentation conducted by the Bureau of Standards, Dr. Stratton's associates declare that he always has kept abreast with the work and invariably could be relied upon for a practical suggestion as to its conduct. He is credited with being particularly apt in recognizing when sight of the objective was being lost and when the work was being permitted to proceed along a tangent—one of the most difficult tendencies to combat in research work.

Long Record of Achievement

The high points of Dr. Stratton's career as prepared for "Who's Who in America" are as follows: Born in Litchfield, Ill., July 18, 1861. He received his B.S. degree at the University of Illinois in 1884. He was an instructor in mathematics, physics and electrical engineering at the University of Illinois from 1885 to 1892, and instructor in physics at the University of Chicago from 1892 to 1901.

Dr. Stratton has received the honorary degree of Doctor of Engineering from the University of Illinois and that of Doctor of Science from the Western University of Pennsylvania, from the University of Cambridge and from Yale. He was made a Chevalier of the Legion of Honor in 1909.

In the war with Spain he served as a Lieutenant in the navy. During the world war he was a member of the Interdepartmental Board of the Council of National Defense and of the National Advisory Committee for Aëronautics.

New York Customs Laboratory to Be Enlarged

Material enlargement of the customs division's chemical laboratory in New York has been recommended to provide facilities for the careful and painstaking chemical determination so necessary to the proper evaluation of dye and chemical imports. It is the plan of the customs division to concentrate all dye tests in New York.

Lecture by Bingham Opens Season for New Jersey Chemical Society

The attendance at the first meeting of the season of the New Jersey Chemical Society would indicate that the members have lost none of their enthusiasm during the summer recess. The meeting room was filled to the doors on Oct. 9, when Prof. Eugene C. Bingham began his address on "Fluidity and Plasticity." Dr. Bingham's talk was practically a summary of his recently published book on the same subject, and it was illustrated with a great many lantern slides.

Dr. Bingham defined his conception of fluidity using as an analogy a pack of cards lying face down on the table and slid upon one another by a horizontal force. This analogy, he said, is fundamental in the proper conception of fluidity. Mathematically, the fluidity is the reciprocal of the viscosity, but determinations of viscosity as a measure of fluidity are apt to be misleading. Instances were quoted in which a 10 per cent difference in the viscosity was observed in the same sample, using different shearing force.

The speaker continued, pointing out the relation between fluidity and plasticity, describing a series of experiments conducted with suspensions of clay in water. Up to a 12 per cent suspension the mixture was obviously a fluid, but at this concentration the fluidity was zero, and it was therefore concluded that above this point the flow of the mud took place in accordance with the laws of plastic flow. If a substance has a definite yield value it is classed as a plastic. The yield value is defined as the force necessary to start movements or flow.

Dr. Bingham described his plastometer, an instrument for determining the plasticity of a substance by forcing it through a small orifice with a definite pressure in a measured time. In the course of his experiments he found that a very small amount (0.1 per cent), of potassium carbonate lowered the yield point about 20 per cent. It was also found that as the temperature of the material was lowered the yield value reaches zero at a transition point somewhat similar to a melting point.

Fertilizer Men Ask for Data on Acid and Phosphate

Collection of statistics of sulphuric acid and acid phosphate as of Nov. 30 for the 6 months previous, with comparative data for 1921, has been suggested to the Department of Commerce by the National Fertilizer Association.

The suggestion carries with it the idea that hereafter such statistics be compiled on May 1 or June 1 and on Nov. 30, giving the trade a semi-annual census. A census for the 6 months previous was compiled last June. Change in data has been suggested so that manufacturers on Nov. 30 may have the benefit of the information in preparing for the spring business.

Reminiscences of a Consulting Chemist

Informal Talk by William Hoskins Before New York Section of Société de Chimie Industrielle

Characterized by a delightful informality and a wealth of personal reminiscences was William Hoskins' talk before the New York Section of the Société de Chimie Industrielle in Rumford Hall on Oct. 13. In introducing the speaker, Dr. Ellwood Hendrick remarked on the policy of the New York Section of this society in characterizing its meetings by a certain human interest which is lacking in the majority of technical society meetings in this country. And certainly this meeting was as full of human interest as one could ask, for Dr. Hoskins gave an intimate sketch of his own career as a consulting chemist, including numerous amusing experiences as a laboratory consultant and his early struggle to gain a livelihood in the profession.

"Analyzing a Race Track"

One of the most amusing incidents told by Dr. Hoskins was that of a client who came to him with the problem of "analyzing a race track." It developed that this client, an engineer, had been commissioned with the project of constructing a race track in Chicago, and he was frank to admit that he knew nothing about the subject. He had heard, however, that the race track at Louisville, Ky., was one of the best in the country and consequently he determined to build the Chicago track as much like it as possible. Dr. Hoskins became interested in the problem and obtained a number of samples of the clay, sand and loam from the Louisville track and by a combination of analytical chemistry, common sense and good luck the race track was finally built and proved to be fully as good as its renowned model. Another of the interesting problems which Dr. Hoskins has encountered was that of studying the smoke problem in Chicago and its relation to the possible electrification of the local railways. In this investigation he and an assistant spent several months in an automobile, sampling air in various sections of the city and finally turned out a very comprehensive report on the subject which was accepted as a piece of pioneer work of its kind.

Dr. Hoskins is extremely modest and was inclined to belittle the work he has done and the friends he has made by his generous advice and help. One could not fail to gather an impression of some of the characteristics of the man which have contributed to his success. For instance, he told of how he built a $5,000 house on a $500 equity, at a weekly salary of $15. He paid for the house by the work he did in his spare time in the basement on the oxy-hydrogen blowpipe.

A client once came to him with a sample of ore. Dr. Hoskins surprised him by asking him from what part of Alaska it came. Pressed for an explanation, he explained that the large number of samples of ores that were brought to him in the course of a year had given him enough experience to be able to tell fairly definitely from what part of the world any particular ore was brought. As a matter of fact, he added confidentially, it was quite simple. The sample was wrapped in a Sitka newspaper.

Experiments With Nickel-Chromium Alloy and Thermit

Dr. Hoskins traced the events in his career which led to the development of the nickel-chromium alloy which he has commercialized for use in pyrometers. When he was 14 years old he saw in a popular magazine a procedure for making synthetic diamonds. He followed the directions and carried on the experiment for 2 years, but, of course, was unsuccessful as far as producing diamonds went. This, however, gave him an interest in synthetic precious stones. Some time later, when he was interested in the oxy-hydrogen blowpipe, he attempted to continue work on this hobby by fusing ruby chips into large rubies. The main difficulty in the way of this ambitious scheme was the lack of funds to purchase small rubies, and he finally gave up the idea of them until Goldschmidt perfected the Thermit process This discovery stimulated his imagination again, and he determined to attempt to make synthetic rubies from ferric oxide and granular alumina. He, therefore, laboriously made up 200 lb. of Thermit and a graphite crucible in which he mxied the ingredients. He conducted the experiment in a blacksmith shop over which lived a colored family. Having made all the preparations he ignited the 200 lb. of Thermit. The colored family upstairs moved out and the fire department appeared on the scene. Needless to say, no rubies resulted from the experiment. This experience with Thermit, however, was recalled to mind when he began working on a nickel-chromium alloy for a thermopile. He successfully applied Thermit to the manufacture of various alloys, but after developing the thermopile it turned out that the practical application of it was very remote, but far from being discouraged with this failure the enthusiastic experimenter applied the very properties of the alloy which made it objectionable for its intended use to other uses. The problem of drawing the new alloy into wire was a long and tedious one, and the inventor encountered many obstacles which, amusing as they seem today, must have been extremely discouraging.

Chapter Officers Elected

Officers of the chapter for the coming year were elected as follows: President, Ellwood Hendrick; vice-president, Raymond F. Bacon; secretary, Arthur W. Thomas; treasurer, T. V. N. Dorr; council, Jerome Alexander, Leo H. Baekeland, M. T. Bogert, George F. Kuns, Charles F. Chandler, Charles H. Herty, D. D. Jackson, Ralph H. McKee, William H. Nichols, Paul Wack, H. C. Parmelee, A. H. Peter, J. E. Zanetti.

C. R. Richards Inaugurated President of Lehigh

Proposes to Extend Engineering Research Activities Without Neglecting Instruction

Before an audience of delegates from other colleges, alumni and undergraduates of Lehigh and friends of the university which crowded the spacious Packer Memorial Chapel, Dr. Charles Russ Richards, former dean of the college of engineering of the University of Illinois, was inaugurated president of Lehigh University on Oct. 15.

In the course of his speech Dr. Richards expressed his idea of the relation between industry and science as follows:

> Since the development of technological science and of technical education has followed rather than preceded the development of the basic industries, it was necessary to build these industries by emperical methods and procedures. Naturally such methods were expensive and wasteful. Only during recent years have we come to understand that there is a limit to our resources and that they must be conserved by every method which modern science can devise.
>
> Undoubtedly the solution of many of the problems of the industries can best and most economically be undertaken through co-operation with the universities and technical schools, in so far at least as these problems involve the discovery of scientific information of basic importance. Educational institutions are interested in the establishment of facts, and work conducted by them is therefore less likely to be affected by prejudices. Furthermore many of these institutions have facilities in apparatus and men which cannot readily be duplicated by any private laboratory. Thus those engaged in engineering research in a modern university have advantages which accrue to them through association with professors of physics, chemistry, bacteriology and other branches of pure science which may have a direct bearing upon engineering investigations in progress.

President Richards struck the note which told his audience that Lehigh, for 60 years a teaching college, was to embark in the great work of engineering research when he stated that "while teaching is the obvious and apparently the chief function of a university, it should be its purpose to place scientific research in a position of equal importance with the work of instruction, for the world must largely depend upon it to extend the boundaries of knowledge and to show its applications to the affairs of life."

Steel Works Offers Jobs to Carnegie Students

To assist students working their way through Carnegie Institute of Technology, the Jones & Laughlin Steel Co., of Pittsburgh, has arranged to employ students in the steel mills on Friday and Saturday nights or all day Saturday. The shifts are of 10 hours length. Jones & Laughlin is the first large concern in Pittsburgh to come to the aid of students in need of financial aid. The arrangement is pleasing to the administration at Carnegie Tech because of the opportunity it gives to the students in the College of Engineering to acquire practical as well as theoretical knowledge.

No Immediate Shortage of Industrial Coal

As a part of its campaign to stabilize the fuel situation through co-operative effort between the government and business, the Chamber of Commerce of the United States has made a survey of coal supplies in the states east of the Mississippi and north of the Ohio River. This part of the country has been regarded as the critical territory in the event of a coal shortage this winter.

The information gathered by the chamber which was obtained through local Chambers of Commerce, has been summarized as follows:

There are practically no supplies in the hands of local dealers.
Public utilities, about 45 days.
Byproduct coke plants fairly well supplied.
Steel works fairly well supplied.
General industries about 45 days.
The bituminous situation is becoming easier.
There seems to be no general complaint as to price.
The critical situation is that of obtaining a sufficient domestic supply in advance of cold weather, especially for the Great Lakes states, and the populous areas of New York State, New England and the Central Atlantic states.
There is much interest being taken in the use of oil.
There is a general increase in the use of coke for domestic fuel.
Certain cities have very effective systems of gathering information and distributing their coal, while others have nothing.

One of the first steps taken by the chamber in its campaign was to call on industries throughout the country to co-operate by confining purchases of coal to current needs as far as possible.

Petroleum Institute and A.C.S. Co-operate on Fuel Problems

First efforts to insure future supplies of motor fuels and oils have been started by the American Petroleum Institute, in co-operation with the special committee of the American Chemical Society which has undertaken the task. A list of problems was submitted at the recent meeting of the society in Pittsburgh, before the Petroleum Section by W. F. Farragher of Mellon Institute, and several of the most important, from a standpoint of immediate needs, have been chosen for immediate attack, as follows:

1. Thorough scientific investigation of fractionating columns. The study will be directed toward greater yields, purity, efficiency of operation, etc.
2. Preparation of rational specifications for petroleum products, such specifications to be based on actual research work. More rational volatility specifications for gasoline, and tests for "oiliness" of lubricants.
3. Investigations as to the actual need of highly refining gasoline for motor fuel; is it necessary to remove bad smelling sulphur compounds completely in order to obtain efficient service from the gasoline? Will these compounds injure the engine?
4. A study of the fundamental causes of carbon formation in cylinders; study effect of addition agents.
5. A thorough study of lubrication from a colloid chemical standpoint.
6. The chemistry of petroleum hydrocarbons, particularly of the higher homologs.
7. The chemistry of the sulphur, nitrogen and oxygen compounds in petroleum.
8. The chemistry of sulphuric acid refining of oils.
9. The causes and mechanism of color changes in oils.

British Prepared for Gas

Significance is attached in Washington to the fact that the British army being landed to protect the Dardanelles is equipped with gas masks. Despite the fact that it is highly improbable that the Turks have any supplies of gas or facilities for using it, each British soldier carries his gas mask ready for instant use in exactly the same way that he did on the western front during the World War.

The work is to be directed by the American Petroleum Institute, the Petroleum Section of the American Chemical Society helping in an advisory capacity only.

The Petroleum Section's committee on petroleum research was appointed to co-operate with Van H. Manning, director of research for the American Petroleum Institute. The following are members: R. R. Matthews, Roxana Petroleum Corporation; R. E. Wilson, Massachusetts Institute of Technology; C. E. Waters, Bureau of Standards; N. A. C. Smith, Bureau of Mines; R. P. Anderson, United Natural Gas Co.; E. W. Dean, Standard Oil Co. of New Jersey; and W. F. Farragher, Mellon Institute of Industrial Research, chairman.

Several Novelties at Ordnance Tests

Demonstrations to Engineers and Technical Men Regarded as Success

Engineers and technical men in the army service regard the demonstration of ordnance material at the Aberdeen Proving Ground on Oct. 6 as the most successful exhibit of this type yet conducted. The principal benefit from the army point of view is to bring home to men of technical experience, who can appreciate the exacting requirements of military prepardness, the destructive agents which may be brought against us. By actually visualizing the engines of war, it is possible to obtain a more precise conception, army officers believe, of the engineering and technical requirements for their production.

While the manipulation of the big guns always constitutes the most interesting portion of the programs at the Proving Grounds, it is believed that the greatest interest centered around the semi-automatic shoulder rifle, which made its first public appearance at the Aberdeen demonstration. The weapon was developed at the Springfield Armory, under the Garand patents. It is believed to be the most notable step forward in rifle production in recent years.

Much interest also centered on a new 14-in. gun on a railway mount. This weapon was displayed publicly for the first time at the meet. It is regarded as a notable achievement to mount on a railroad car a gun 50 ft. in length, capable of hurling a 1,500-lb. projectile a distance of 23 miles.

Another of the Ordnance Department's recent achievements which was on display was a new supersensitive fused shell which will burst on the slightest contact, even if nothing more substantial than the cloth of an airplane wing is pierced.

Radio was successfully employed in directing tank operations. A tractor for reconnaisance purposes was demonstrated publicly for the first time. Special provision is made to facilitate observation on the part of the two officers which the tractor is designed to carry. It has a speed of 12 miles across country and is equipped so as to float when it is necessary to cross streams.

Salesmen Enthusiastic Over Chemical Courses

The tower banquet hall of the College of the City of New York was the scene of the opening fall meeting of the New York Chapter of the Salesmen's Association of the American Chemical Industry on Oct. 13. The annual election of officers of the New York Chapter resulted in the appointment of John A. Chew, sales manager of the Warner Chemical Co., as president, George Ashworth, of the Dow Chemical Co., as treasurer, and D. H. Killeffer, of the *Journal of Industrial and Engineering Chemistry*, as secretary.

The excellent dinner which was arranged through the co-operation of Drs. Breithut, Robinson and Moody, was thoroughly enjoyed as was attested by the fact that the members lingered around the table until 9 o'clock. The meeting then adjourned to the Doremus chemical lecture room, where Dr. F. E. Breithut presented a series of experiments with liquid air which were exceedingly interesting. Dr. Breithut then outlined a proposed series of lectures on "The Chemistry of Common Things," which he plans to organize for the association. He outlined the scope of the course and the facilities for co-operative work. It is planned to make the lectures of a very practical nature and to present information that will be of great value to salesmen in the chemical industry. The first lecture will describe how a chemist works. This will be followed by a series of talks on the chemistry of gases, liquids, solids, solutions, acids and alkalis, metals and their source, carbon and its compounds. The ninth lecture, on "The Language of Chemistry," will go into the nomenclature which is sometimes so puzzling to the layman. The final lecture will be on "Economic Chemistry," a subject which Dr. Breithut is especially well qualified to discuss.

The association membership received the proposal with great enthusiasm. From the fifty members who were present at the meeting, thirty-three subscriptions to the course were obtained, and it is practically assured that the necessary quota of fifty members will be made up in a short time and the course started.

To Educate Legislators on Importance of Chemical Industry

So that new members entering the Senate or the House of Representatives may be given an idea, in concise form, of the value of chemistry to the nation, the American Chemical Society is bringing out a syllabus which it will place in their hands. It also is to be circulated in a limited way to others with the idea of emphasizing the essential nature of an American chemical industry. The concise character of the production may be gained from the reference made to the importance of chemistry to the national defense. It follows:

"Chemistry is essential to the production of every type of material required for national defense. War involves the entire national resources of a country, and the nation best fitted to make full use of its resources is most likely to be the victor. Without far-reaching work by chemists, such ability to defend a country is negligible. The German general Ludendorff in an interview published in American newspapers Sunday, Oct. 8, 1922, declared that in the next great war airships, chemicals and a few regiments of highly trained men will be supreme. Chemistry produces explosives, materials for aviation from dope for airplane wings to helium for dirigibles, materials for camouflage, toxic gases and equipment for protection against gases. Many non-poisonous smoke-screens, tear gas and other materials for 'humane warfare' are due to chemistry. It is the controlling factor in ordnance, in medicine and in sanitation. Its importance in national defense can not be overestimated."

Synthetic Organic Manufacturers Consider Tariff Effects

A meeting of the Synthetic Organic Chemical Manufacturers Association was held on Oct. 13 at the Hotel Pennsylvania, New York, with sixty representatives of chemical manufacturers present. The morning session was devoted to a meeting of the general association and the afternoon to meetings of the Dyestuffs Section, Crudes and Intermediates Section and the Medicinal and Fine Organic Chemicals Section.

At the conclusion of the luncheon held after the adjournment of the general session, the manufacturers were addressed by Dr. John H. Finley of the editorial staff of the New York *Times*. Dr. Finley emphasized the importance of the industry represented at the meeting and the multiplicity of the products so essential to the other industries of the country, and commented especially on the work of the chemists and the chemical manufacturers in transforming crude material of but little value to such highly important compounds as dyes, medicinals, etc. He felt that the present stress of the industry was due to lack of public understanding and pointed out how important a role the press of the country could play in bringing about a full conception by the people of the entire country that in this industry lay a national asset which should be safeguarded in every possible way. Regardless of the general views of tariff protection, he unhesitatingly joined with the views which he quoted of the late Lord Moulton, the eminent free-trader of England, that such an industry is exceptional in its character and in its preservation all citizens should unite.

At the general session of the association the subject of prime interest was the probable effect upon the industry of the present tariff act. There was a unanimity of feeling that many important products were markedly unprotected and all felt the injustice of the situation which took from the President power to increase rates where it could be clearly shown that protection was inadequate. As to direct effects up to date of the bill, it developed that as yet but little of the material manufactured by this industry had been admitted into this country, as the Customs Division had not yet drafted its regulations for administering the many complicated features in the new bill. The manufacturers, therefore, would have to wait before they could determine very accurately how disastrous foreign competition would prove.

Personal

Dr. JOSHUA BERNHARDT, of Rochester, N. Y., has been appointed head of the Tariff Commission's Sugar Division. Dr. Bernhardt served during the war as a sugar specialist for the Food Administration and for the Sugar Equalization Board. He is the author of a two-volume work on "Government Control of the Sugar Industry and Trade" and of another two-volume treatise under the title of "A Statistical Survey of the Sugar Industry and Trade." For the past 18 months Dr. Bernhardt has been a member of the staff of the Institute of Government Research and has written monographs covering the work of the Tariff Commission, the Alaskan Engineering Commission, the Interstate Commerce Commission, the Railroad Labor Board and the Federal Reserve Board. He was educated at the University of Rochester and at Johns Hopkins University.

C. R. DELONG, who recently left the United States Tariff Commission to take charge of the Chemical Commodity Division for the Department of Commerce, has been selected to return to the Tariff Commission as head of its Chemical Division.

Dr. MARION DORSET, chief of the Biochemical Division of the Bureau of Animal Industry, Department of Agriculture, has been designated to cooperate in an unofficial and consultative capacity with the Anthrax Advisory Committee. Dr. Dorset has been connected with the Department of Agriculture since 1894, and has held his present office since 1904.

CHARLES R. DOWNS and JOHN M. WEISS, of New York, were awarded the Howard N. Potts medal by the committee on science and the arts of the Franklin Institute. The award was made "in consideration of their notable achievement in the scientific and commercial development of the catalytic vapor-phase oxidation of benzene to maleic acid and their pioneer work in developing a commercial process for changing aromatic to aliphatic compounds."

Dr. A. R. FORTSCH, of the Iowa State University, will become research chemist in the laboratory of the Standard Oil Co. at Whiting, Indiana.

W. S. LANDIS, chief technologist for the American Cyanamid Co., was given the degree of D.Sc. on Oct. 15 by Lehigh University. HARLAN S. MINER, chief chemist for the Welsbach Co., received the same honor. Both gentlemen are alumni of Lehigh.

C. C. LATUS gave an interesting address before the members of the Pittsburgh Paint, Oil and Varnish Club, Pittsburgh, Pa., on Oct. 5, on the subject, "An Economic View of Central Europe."

ERNEST T. TRIGG has been elected president of John Lucas & Co., Philadelphia, Pa., manufacturers of paints and varnishes, succeeding J. W. LUCAS, who has become chairman of the board of directors. JAMES F. LUCAS was elected vice-president to succeed Mr. Trigg.

Obituary

WILLIAM C. ALLEN, general manager of the Tarrant Co., manufacturer of chemicals, died at his home in Brooklyn, N. Y., Sept. 24, as the result of injuries received when struck by an automobile. He was born in 1844, and had been associated with the Tarrant Co. for the past 50 years.

T. K. MCKNIGHT, who represented Crane Co. in Cleveland and formerly held a similar position in the Detroit and Pittsburgh districts, died suddenly in Cleveland on Sept. 16.

FRANK SHERMAN WASHBURN, chairman of the board of directors of the American Cyanamid Co., a leader in American engineering, died at his home in Rye, N. Y., at 2:30 a.m. Monday, Oct. 9. Death was due to bronchial pneumonia. Mr. Washburn is survived by his wife, a son, a daughter and two sisters, Mrs. C. J. Swan and Mrs. G. R. Dean, both of Chicago.

DR. J. FLEMING WHITE, consulting chemist for the General Chemical Co. for the past 37 years, died at his residence in Buffalo, N. Y., on Sept. 25, aged 73 years. Prior to becoming connected with the General Chemical organization he was connected with Harvard University and engaged in research work for the government.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities Prevailing Prices and Market Letters From Principal Industrial Centers

How About Our Foreign Trade?

An Attempt to Answer This Question by a Study of the General Trend of Imports and Exports of Basic Commodities and of Chemical and Allied Products

WHAT influence will the new high-protective tariff have on our foreign trade? Can we continue to export if imports are shut off? What will become of our favorable balance of trade? Questions of this sort will not down even though their answers for the most part must wait for the tedious process of international readjustment. Certain it is, of course, that the great groups of commodities for which the world must depend on the United States will continue in demand, although the extent of this demand must be measured by the foreigner's ability to pay. Likewise this country will continue to import necessities and other materials not produced here. Certain commodities for which the preference is for the foreign product will also be imported in spite of higher duties. Here, however, the quantity will depend on our willingness rather than ability to pay the price. The first 6 months of the current year showed a very encouraging trend in our foreign trade. After our exports had reached a low point in February, 1922, there was a distinct upward movement as exports rose from the low of 251 million dollars to 335 millions in June. The lowest point reached in imports since the decline which began in 1920 was in July, 1921. Month by month since that time the value of our imports has increased from 178 million dollars in July, 1921, to 260 millions in June and to 281 millions in August, 1922. The latter month to a large extent reflects the flood of imported merchandise received in anticipation of the enactment of the new high tariff. The monthly totals for August, which have just been issued by the Bureau of Foreign and Domestic Commerce, are shown in Table I.

Our balance of trade—i.e., the excess of exports over imports, has been gradually dwindling. In the fiscal year 1921-22 it amounted to 1,163 million dollars, as compared with 1,976 millions in the calendar year 1921 and 2,862 millions in the fiscal year 1920-21. The Research Division of the Bureau points out that although the trade balance in 1921-22 was slightly more than one-fourth as large as that for the fiscal year 1918-19 and less than half that of 1917-18 and 1919-20, it was nevertheless two and one-half times as large as the balance for 1913-14—a typical pre-war year. In 1913-14 the excess of exports over imports was 11 per cent of the total trade; last year it was 18 per cent.

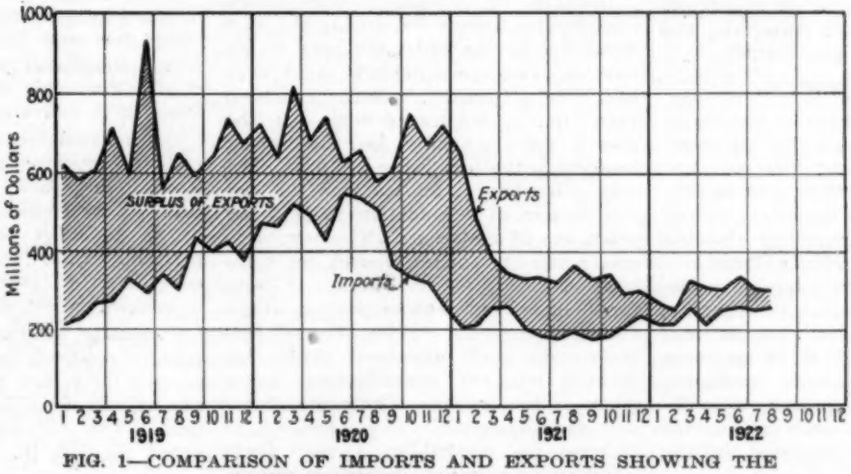

FIG. 1—COMPARISON OF IMPORTS AND EXPORTS SHOWING THE DIMINISHING BALANCE OF TRADE

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	153.77
Last week	150.78
October, 1921	151
October, 1920	263
April, 1918 (high)	286
April, 1921 (low)	140

Of the twenty-five commodities included in this index four advanced in price, there was one decline and the prices of the remainder did not change. Methanol, glycerine, formaldehyde and aniline oil caused an increase in the index number which more than offset the slight decrease caused by caustic potash.

The spread between imports and exports is shown graphically in Fig. 1. Its dwindling tendency is particularly significant in view of the commonly held theory that as a creditor nation our favorable trade balance must ultimately change to an unfavorable one. The new Chemical Division of the Department of Commerce has recently announced that since our export trade in chemicals and allied products is increasing so rapidly, it is quite probable that the total for 1922 will exceed that for 1921. This statement is supported by the fact that our exports for the first 7 months of 1922 showed a decrease of 3 per cent over

TABLE I—ANALYSIS OF FOREIGN COMMERCE FOR THE MONTH OF AUGUST, 1922

Groups	Month of August 1922	Month of August 1921	8 Months Ended August 1922	8 Months Ended August 1921
Imports				
Crude materials for use in manufacturing	$110,285,850	$71,525,960	$696,969,883	$563,733,290
Foodstuffs, crude, and food animals	22,489,316	18,921,616	211,856,654	202,007,847
Foodstuffs, partly or wholly manufactured	42,404,794	27,096,025	275,212,363	274,869,332
Manufactures for further use in manufact'g	48,430,514	25,160,325	328,283,585	227,588,260
Manufactures ready for consumption	55,858,174	49,889,223	430,881,213	408,745,339
Miscellaneous	1,944,262	2,175,602	9,752,898	11,460,167
Total imports	$281,412,910	$194,768,751	$1,952,956,596	$1,693,404,235
Exports				
Crude materials for use in manufacturing	$47,872,888	$65,278,951	$519,644,391	$615,798,544
Foodstuffs, crude, and food animals	61,339,609	105,877,509	292,791,310	525,643,525
Foodstuffs, partly or wholly manufactured	46,071,986	66,607,308	404,066,204	479,278,830
Manufactures for further use in manufact'g	35,708,965	25,050,067	309,005,058	275,884,025
Manufactures ready for consumption	104,871,560	97,318,160	847,925,438	1,241,888,759
Miscellaneous	407,071	493,641	4,296,754	4,666,999
Total domestic exports	$296,272,079	$360,625,636	$2,377,729,155	$3,143,160,682
Foreign merchandise exported	5,532,539	6,261,902	46,058,717	83,386,144
Total exports	$301,804,618	$366,887,538	$2,423,787,872	$3,226,546,826

the corresponding period of 1921, while the exports for the first eight months of 1922 showed only a very slight decrease—less than 1 per cent—over the same period in 1921. Going back over our exports month by month for the first 8 months of these 2 years, the rate of decrease has been gradually lessened, from 28 per cent for the first quarter to less than 1 per cent for the 8 months ended Aug. 31. Table II shows by monthly periods the gradual improvement in our export trade.

TABLE II—MONTHLY IMPROVEMENT IN CHEMICAL EXPORTS

Period	Decrease in Value of Exports in 1922 Over 1921 Per Cent
January	53
January – February	43
January – March	28
January – April	20
January – May	11
January – June	7
January – July	3
January – August	0.8

When it is taken into account that this table is based on value, it can be readily seen that with continued improvement our export trade in chemicals for 1922 will show an encouraging increase over 1921.

The total exports of chemicals and allied products for the first 8 months of 1922 were valued at $71,476,203, as compared with $72,081,335 in the corresponding period of 1921. Marked increases again occurred in our exports of fertilizers and fertilizer materials, and in naval stores, gums and resins.

Commodity Totals

Caustic soda and borax continued to show the largest increases of all chemicals, 360 per cent and 300 per cent respectively, 107,934,500 lb. and 10,361,250 lb., having been exported during this period. Other chemicals showing important increases were sodium silicate, bleaching powder, glycerine, acetate of lime, sodium bicarbonate, ammonium sulphate and copper sulphate. Of the 4,218,288 lb. of ammonia and ammonium compounds (excluding ammonia sulphate) exported, it is interesting to note that over one-quarter of the amount was exported in the month of August.

The shipments of fertilizers and fertilizer materials were 652,359 tons, valued at $12,032,707, in 1922, as compared with 561,666 tons, valued at $10,363,628, in 1921, an increase of nearly 20 per cent in quantity. Of a total of 111,676 tons of ammonia sulphate exported, over one-half was again shipped to Japan and one-quarter was sent to Spain.

Large increases are again noticed in the exports of naval stores, the combined exports of tar, pitch and wood turpentine increasing 260 per cent, while spirits of turpentine increased 67 per cent and rosin 58 per cent. The United Kingdom still continues to be our best customer for rosin and spirits of turpentine, taking nearly one-third and one-half respectively by value. The total exports of naval stores were $11,348,000 in 1922, as compared with $6,843,000 in 1921.

The exports of explosives more than doubled in this period, from 5,692,000 lb. ($1,361,000) in 1921, to 11,657,000 lb. ($2,121,300) in 1922. The amount of dynamite exported increased from 5,032,860 lb. in 1921, to 8,235,000 lb. in 1922.

Perfumeries, cosmetics and all toilet preparations increased over one-quarter from a total valuation of $3,000,000 in 1921 to nearly $4,000,000 in 1922.

Although the figures for the exports of "Pigments, paints and varnishes" still continue to indicate a decrease in exports from $9,009,000 in 1921 to $7,329,000 in 1922, there were marked increases in the exports of red lead and litharge and in zinc oxide, from less than 1,000,000 lb. and 3,000,000 lb., respectively, in 1921, to nearly 2,500,000 lb. and 5,000,000 lb. in 1922. Decreases are still evident in the exports of ready-mixed paints, white lead, and other paints.

Other noticeable decreases were in the exports of benzol, from $2,582,600 in 1921 to 1,994,000 in 1922, and coal-tar colors, dyes and stains other than color lakes, from $3,767,400 to $2,431,400.

The New York Market

New York, Oct. 16, 1922.

Inquiries by consumers have shown considerable diminution during the past week, due to the price advances which have occurred since the new tariff went into effect. Interest, however, has been keen among leading dealers, as the present market has reached the highest level since the beginning of 1921. The only disturbing influence was the announcement of a reduction in price by producers of oxalic acid. The new price was primarily made to meet the competition of foreign makers. Alkalis for home consumption showed an abundance of activity. Producers of formaldehyde again advanced prices, increased cost of manufacture being given as the reason. The acute shortage in commercial white arsenic is keeping the market in a very tight position on spot and immediate future shipments. There has been a slight decrease in quotations of caustic potash and barium chloride. Weak holders of these items have offered some round lots during the week at lower figures, but consumers have shown little desire to increase their stocks. Acetate of soda remains scarce and strong on spot. Prussiate of potash and soda are holding their late advances and several fair-sized lots have been sold. The market, in general, appears on the road to stable prosperity and some of the leaders are looking forward to the last quarter of 1922 with unusual optimism.

General and Special Chemicals

Arsenic—Spot material has been selling around 10c. per lb. This figure is the highest recorded since the early part of 1921. The consuming trade, largely producers of insecticides, are very active. Forward shipments are bringing 9½@9¾c. per lb.

Barium Chloride—Quotations among some dealers were slightly lower, with figures ranging around $100@$102 per ton. Leading producers are quoting $105. The demand has not, however, been active during the past week.

Caustic Potash—The 88-92 per cent imported material has been sold at 6¼c. per lb., but the majority of strong holders are asking 6½c. There was a fair inquiry in the market, although actual sales were not as extensive as recorded a week ago.

Caustic Soda—Export business has been quite dull of late and prices have reduced to $3.45@$3.50 per 100 lb. for standard brand goods. The only real activity is in the domestic consumption, where prices are holding at 3¾c. per lb. Contract price quotations remain unchanged.

Chlorate of Potash—Imported material is quoted at 7½@7¾c. per lb. The market has been quite firm at these figures and demand continued active. Domestic factors quote 8½c. per lb.

Chlorate of Soda—Domestic producers are firm at 6½c. per lb., f.o.b. works and report a moderate amount of new business at this level. Imported goods is strongly maintained at 6½c. per lb. on spot.

Formaldehyde — Manufacturers announced an advance to 11½c. per lb. on round lots and 12c. for smaller quantities. Increased price of methanol is chiefly the cause of the late advance. Demand is active.

Oxalic Acid—Sales of imported material are reported at 13¾c. per lb. for arrival, duty paid. American manufacturers have reduced prices to 14c. per lb., in an effort to meet foreign competition. Spot domestic goods are quoted at 16c. per lb., but the market is somewhat irregular.

Prussiate of Potash — Leading importers reported sales at 38½c. per lb. on spot for yellow material. Shipments are offered at 37½@38c. per lb., duty paid. The red variety is offered at about 95c. per lb.

Soda Ash—The spot market is firmly held at $1.75 per 100 lb., single bags, and $1.95 in barrels, carload lots. Contract business was reported quite active among producers at $1.20 per 100 lb., basis 48 per cent, f.o.b. works.

Coal-Tar Products

The market on crude coal-tar material presented a very strong appearance and acute advances were reported in several items. Phenol has been the feature of this market and spot goods were exceedingly scarce. Cresol, U.S.P., has been advanced 2c. per lb. by producers. Cresylic acid has also recorded gains ranging from 3@4c. per gal. The consuming trades have shown considerable activity of late and the increased prices are primarily on account of this demand. Aniline oil producers are quite firm at the recently advanced figures.

Naphthalene has remained quiet and several weak holders are shading prices in an effort to move stocks. Benzene and toluene are very strong and can only be quoted for future shipments.

Cresol—U.S.P. material has advanced to 14c. per lb. in bulk and to 20c. on smaller quantities.

Phenol—The spot market is very tight. Several sales have been made at 26c. per lb. for prime white U.S.P. crystals. Manufacturers are sold up well into the future and the general condition is very strong.

The Chicago Market

CHICAGO, OCT. 12, 1922.

The chemical market was in a much healthier condition the past 2 weeks and it appeared that this condition would be more or less permanent. Labor troubles have about ceased and transportation difficulties are gradually being adjusted, with the result that business in general is better than for some time past. Prices, as a rule, were very firm, with advances numerous. However, these advances were mainly on imported materials that were affected by the new tariff. Supplies were not heavy in any direction, but with one or two exceptions no serious shortages were in evidence.

GENERAL CHEMICALS

Caustic soda maintained its firm position and was reported to be moving in a good volume. The solid 76 per cent material was offered at $3.50@$3.75 per 100 lb., priced according to quantity and holder, while the ground of the same test was quoted at $4.25@$4.50. *Caustic potash* was available in one direction at 7¼c. for the 88-92 per cent material, but most factors held their prices firm at 7½c. *Soda ash* was in good demand and was quoted in cooperage at $2.25 per 100 lb. delivered to the buyer's plant. *Sal soda* moved in a routine way at $1.90 per 100 lb.

Potash alum was very firm, with 5½c. per lb. the inside price on the iron-free lumps. The powdered material of the same grade was scarce at 6½c. per lb. in large casks. *Sal ammoniac* continued firm, with 7¾c. per lb. the best price noted for the 98-100 per cent white granular. All barium salts were in a firm position, with only moderate supplies available. *Barium chloride* was quoted in small lots by one factor at $110 per ton but it was doubtful if a large order could have been taken care of. The carbonate was quoted for spot delivery at $90 per ton, but, like the chloride, only limited supplies were available. Bleach was firm, with $2.60 per 100 lb. the prevailing price for small or moderate lots. *Copper sulphate* was available in fair quantities at 6@6½c. per lb. *Carbon tetrachloride* was unchanged and apparently enjoyed a good demand. The large drums were quoted at 9c. per lb. delivered to the buyer's store. *Carbon bisulphide* was scarce on spot and supplies were firmly held at 7½c. per lb. *Formaldehyde* was again sharply advanced, the new level being 12½c. for barrels in less than carload lots. *Furfural* was reduced to 25c. per lb. in ton lots. Glycerine was steady at 18½c. per lb. for the c.p. material in drums. *Magnesium* metal was quiet at $1.35 per lb. for the powder. *Phosphoric anhydride* was in poor demand and was offered in 1-lb. tins at 42c. per lb.

Bichromates were steady and moved in a fair volume. *Potassium bichromate* was quoted in single barrels at 12@13c. per lb. and the *soda* at 9@9½c. *Potassium permanganate* was easier and spot supplies of the U.S.P. crystals were available at 18c. per lb. *Red prussiate of potash* was offered in very small quantities by one holder at 92c. per lb. The *yellow prussiate of potash* was scarce at 38c. per lb.

LINSEED OIL AND TURPENTINE

Turpentine was considered high priced by most consumers and only small quantities for immediate consumption were sold. Today's price for single drums was $1.45 per gal.

Linseed oil moved in a better way, but very few consumers were taking on supplies beyond their immediate needs. The boiled oil was quoted today at 96c. per gal. in single drums and the raw at 94c.

The Iron and Steel Market

PITTSBURGH, Oct. 13, 1922.

Fundamental conditions in the steel market have turned distinctly soft, but in the actual current market there is little softness apparent, there being support, both real and sentimental, by the existing transportation difficulties, which prevent full shipments being made from mill in all cases and which also block delivery, more or less, to various consumers.

There are car shortages at the majority of steel plants, and there are probably few at which there is not some accumulation of finished steel. No large tonnage has piled up. Whether correctly or not, it was estimated in some quarters on July 1, 1920, that 3,000,000 tons of finished steel lay at mill, awaiting cars. An estimate now would not be a tenth of that amount.

EFFECTS OF CAR SHORTAGE

While the steel mills probably could make little if any more steel than they are making, there is no desire to make more, since it is impossible to ship all the steel that is being made. When the market has the physical and moral support of shipments restricted by transportation conditions and does not appear particularly strong at that, it is evident that it is on the verge of the general readjustment that was expected to follow at a longer or shorter interval the ending of the coal strike. In April and May it was a very common view that the coal strike, by its sentimental influence, was making the steel market stronger and more active than it would be otherwise.

Delivery premiums continue on some steel products, but are tending to narrow, and probably will shortly disappear entirely. Basis prices naturally could not be expected to yield when there is a premium market in some branches of the trade, but they may yield later, and unless circumstances that cannot now be foreseen should arise it is entirely probable that basis prices will eventually decline, before there is another general buying movement in steel. The experience of two years ago will be repeated on a smaller scale. Steel prices have very much less room for decline, but the character of the market will not be essentially different.

Bars, shapes and plates are quotable generally at 2@2.25c. Black sheets in the open market are at 3.50@3.60c. The Steel Corporation's price is 3.35c., but it is out of the market. One or two mills are asking 3.75c., but do not seem to be selling much tonnage. Nails are steady at $2.70.

The Steel Corporation's unfilled obligations increased by 741,502 tons in September, against increases of 173,944 tons in August and 140,630 tons in July. The September showing is not illuminating because it is not known how much of the large rail tonnage put under cover in the month got into actual form for entering before the close of the month. Some of the business remained to appear in the October statement. With rails eliminated the September showing would probably not be much different from those of the two preceding months.

COKE AND IRON PRICES

Connellsville coke and merchant pig iron have just begun an extensive price readjustment. Coke was strong for several weeks, at around $12, and furnaces desiring to buy in order to resume operations had to buy from several different plants to make up the tonnage. In the past few days prices have suddenly begun to weaken, and with its usual sensitiveness the market will probably decline sharply. A week ago the market was strong at $12, while now coke is offered at $11 with few takers. Coke has sometimes sold at less than the market price of the coal involved, plus cost of coking. The computation at present would be 1½ times $3.50 plus $1.25, or $6.50. By precedent, coke could sell for less than $6.50 or it could sell at double that figure, according to whether the balance between offerings and demand were disturbed a trifle one way or the other.

Cherry Valley furnace and McKeefrey furnace, both at Leetonia, Ohio, are about to get into blast. While merchant furnace resumptions have been only occasional, there has really been a fair measure of resumptions, and with pig iron scarcely salable in the past few weeks at prices asked, a substantial decline in the market is to be expected. The market now is quotable, roughly, at $31 for basic, $33.50 for bessemer and $32.50 for foundry, f.o.b. valleys or Johnstown, freight to Pittsburgh being $1.77 in each case. There are no definite bids, representing prices at which consumers would buy freely.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.	–	$0.38 – $0.40
Acetone	lb.	$0 17½ – $0 17½	.18 – .18½
Acid, acetic, 28 per cent	100 lb.	2.80 – 2.90	2.95 – 3.50
Acetic, 56 per cent	100 lb.	5.60 – 5.75	5.80 – 6.25
Acetic, glacial, 99½ per cent, carboys,	100 lb.	11.00 – 11.25	11.50 – 12.00
Boric, crystals	lb.	.11 – .11½	.11½ – .12
Boric, powder	lb.	.11 – .11½	.11½ – .12½
Citric	lb.	–	.52 – .52½
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11½ – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04½ – .04½	.05 – .05½
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)		–	–
Nitric, 40 deg.	lb.	.06 – .06½	.06½ – .07
Nitric, 42 deg.	lb.	.06½ – .06½	.07 – .07½
Oxalic, crystals	lb.	.15 – .15½	.15½ – .16
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08½ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	–	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.50 – 10.00	–
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	–
Sulphuric, 66 deg., tank cars	ton	15.00 – 16.00	–
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	–	–
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	–
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	–	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	–	.31 – .31½
Tartaric acid, imported, powdered	lb.	–	.31½ – .32
Tartaric acid, domestic	lb.	–	– .32
Tungstic, per lb. of WO	lb.	–	1.00 – .110c
Alcohol, ethyl (Cologne spirit)	gal.	–	4.75 – 4.95
Alcohol, methyl (see methanol)		–	–
Alcohol, denatured, 188 proof No. 1	gal.	–	.36 – .38
Alcohol, denatured, 188 proof No. 5	gal.	–	.36 – .38
Alum, ammonia, lump	lb.	.03½ – .03½	.03½ – .04
Alum, potash, lump	lb.	.03½ – .03½	.04 – .04½
Alum, chrome lump	lb.	.05 – .05½	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02½	.03 – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06½ – .07½	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08½ – .08½	.09 – .09½
Ammonium nitrate	lb.	.06 – .06½	.06½ – .07½
Amylacetate tech.	gal.	–	2.35 – 2.50
Arsenic, white, powdered	lb.	.10 – .10½	.10½ – .10½
Arsenic, red, powdered	lb.	.12 – .12½	.12½ – .13
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	100.00 – 102.00	103.00 – 105.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate		.09 – .09½	.09½ – .10
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½ – .04½
Blanc fixe, dry	lb.	.04 – .04½	–
Blanc fixe, pulp	ton	45.00 – 55.00	–
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)		–	–
Borax	lb.	.05½ – .05½	.06 – .06½
Brimstone (see sulphur, roll)		–	–
Bromine	lb.	.27 – .38	.28½ – .35
Calcium acetate	100 lb.	2.75 – 2.85	2.90 – 3.25
Calcium carbide	lb.	.04½ – .04½	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01½	.02 – .02½
Calcium peroxide	lb.	–	1.40 – 1.50
Calcium phosphate, tribasic	lb.	–	.15 – .16
Camphor	lb.	–	.86 – .87
Carbon bisulphide	lb.	.06½ – .07	.07½ – .07½
Carbon tetrachloride, drums	lb.	.10 – .10½	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	–	.60 – .75
Caustic potash (see potassium hydroxide)		–	–
Caustic soda (see sodium hydroxide)		–	–
Chalk, precip.—domestic, light	lb.	.04½ – .04½	–
Chalk, precip.—domestic, heavy	lb.	.03½ – .03½	–
Chalk, precip.—imported, light	lb.	.04½ – .05	–
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05½ – .06
Chloroform	lb.	–	.25 – .32
Cobalt oxide	lb.	–	2.00 – 2.10
Copperas	ton	20.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.20 – .20½	.20½ – .21
Copper cyanide	lb.	–	.58 – .600
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.504
Cream of tartar	lb.	–	.26 – .27
Epsom salt (see magnesium sulphate)		–	–
Ethyl acetate com. 85%	gal.	–	.60 – .65
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	–	.90 – .95
Formaldehyde, 40 per cent	lb.	.11½ – .11½	.12 – .12½
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	–
Fullers earth—imported powdered	net ton	30.00 – 32.00	–
Fuse oil, ref.	gal.	–	2.75 – 2.90
Fusel oil, crude	gal.	–	1.65 – 1.85
Glauber's salt (see sodium sulphate)		–	–
Glycerine, c.p. drums extra	lb.	–	.18½ – .18½
Iodine, resublimed	lb.	–	4.40 – 4.50
Iron oxide, red	lb.	–	.12 – .18
Lead acetate, white crystals	lb.	–	.11½ – .12½
Lead arsenate, powd.	lb.	.13 – .13½	.13½ – .14½
Lead nitrate	lb.	–	.15 – .20
Litharge	lb.	.07½ – .08	.08½ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06½ – .07½
Magnesium sulphate, U.S.P.	100 lb.	2.00 – 2.25	2.30 – 2.50
Magnesium sulphate, technical	100 lb.	–	1.00 – 1.80
Methanol, 95%	gal.	–	.82 – .84
Methanol, 97%	gal.	–	.86 – .88
Nickel salt, double	lb.	–	.11 – .11½
Nickel salt, single	lb.	–	.12 – .12½
Phogene (see carbonyl chloride)		–	–
Phosphorus, red	lb.	–	.40 – .45
Phosphorus, yellow	lb.	–	.30 – .35½
Potassium bichromate	lb.	.10 – .10½	.10½ – .11
Potassium bromide, granular	lb.	–	.17 – .23
Potassium carbonate, U. S. P.	lb	.12 – .12½	.13 – .16
Potassium carbonate, 80-85%	lb.	.06 – .06½	.06½ – .06½
Potassium chlorate (powdered and crystals)	lb.	.07½ – .07½	.08 – .08½
Potassium cyanide	lb.	–	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.25 – 6.50	6.60 – 7.00
Potassium iodide	lb.	–	3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06½	.07 – .08
Potassium permanganate	lb.	.17 – .17½	.17½ – .19
Potassium prussiate, red	lb.	–	.95 – 1.00
Potassium prussiate, yellow	lb.	.38½ – .38½	.39 – .39½
Rochelle salts (see sodium potas. tartrate)		–	–
Salammoniac, white, granular	lb.	.06½ – .07	.07½ – .07½
Salammoniac, gray, granular	lb.	.07½ – .08	.08½ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 – 27.00	–
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.08 – .08½	.08½ – .09
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07½	.08 – .08½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04½	.04½ – .05½
Sodium chlorate	lb.	.06½ – .06½	.07 – .07½
Sodium chloride	long ton	12.00 – 13.00	–
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09 – .09½	.09½ – .10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.45 – 3.50	3.55 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .02½	.03 – .03½
Sodium nitrite	lb.	.09½ – .09½	.09½ – .10
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04½ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	–	.18 – .21
Sodium prussiate, yellow	lb.	.24 – .24½	.24½ – .25
Sodium silicate, (40 deg. in drums)	100 lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (cone.)	lb.	.04 – .04½	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03½	.03½ – .04½
Strontium nitrate, powdered	lb.	.09½ – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 – 20.00	–
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	–	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 – 40.00	–
Talc—domestic powdered	ton	18.00 – 25.00	–
Tin bichloride	lb.	.10 – .10½	.10½ – .10½
Tin oxide	lb.	–	.39 – .40
Zinc carbonate	lb.	.14 – .14½	.14½ – .15½
Zinc chloride, gran.	lb.	.06 – .06½	.06½ – .07
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08½ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.95 — $1.00
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.29 — .31
Aniline oil, drums extra	lb.	.16 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb	.80 — .85
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech.	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.53 — .55
Beta-naphthol, tech	lb.	.23 — .25
Beta-naphthyla mine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97-99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 75-97%, dark, in drums	gal.	.55 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.32 — .34
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.72 — .75
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.72 — .75
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06½
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35

Nitro-toluene	lb.	$0.15	— $0.10
N-W acid	lb.	1.20	— 1.30
Ortho-amidophenol	lb.	2.10	— 2.15
Ortho-dichlor-benzene	lb.	.17	— .20
Ortho-nitro-phenol	lb.	.80	— .85
Ortho-nitro-toluene	lb.	.10	— .13
Ortho-toluidine	lb.	.12	— .14
Para-amidophenol, base	lb.	1.20	— 1.25
Para-amidophenol, HCl	lb.	1.25	— 1.30
Para-dichlorbenzene	lb.	.17	— .20
Paranitroaniline	lb.	.72	— .80
Para-nitrotoluene	lb.	.55	— .65
Para-phenylenediamine	lb.	1.55	— 1.60
Para-toluidine	lb.	.85	— .90
Phthalic anhydride	lb.	.35	— .38
Phenol, U. S. P., drums	lb.	.26	— .27
Pyridine	gal.	1.60	— 1.75
Resorcinol, technical	lb.	1.50	— 1.55
Resorcinol, pure	lb.	2.00	— 2.10
R-salt	lb.	.55	— .60
Salicylic acid, tech., in bbls	lb.	.29	— .30
Salicylic acid, U. S. P	lb.	.32	— .34
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27	— .32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.12	— .14
Sulphanilic acid, crude	lb.	.24	— .26
Tolidine	lb.	1.20	— 1.30
Toluidine, mixed	lb.	.30	— .35
Toluene, in tank cars	gal.	.25	— .28
Toluene, in drums	gal.	.30	— .35
Xylidines, drums, 100 gal	lb.	.40	— .45
Xylene, pure, in drums	gal.	.40	— .45
Xylene, pure, in tank cars	gal.	.45	— ....
Xylene, commercial, in drums, 100 gal	gal.	.33	— .35
Xylene, commercial, in tank cars	gal.	.30	— ....

Waxes

Prices remain same as previous report

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.70	— ....
Rosin E-I	280 lb.	6.70	—
Rosin K-N	280 lb.	6.75	— $6.85
Rosin W. G.-W. W	280 lb.	7.75	— 8.25
Wood rosin, bbl	280 lb.	6.25	—
Spirits of turpentine	gal.	1.45	— 1.46
Wood turpentine, steam dist	gal.	1.15	— ....
Wood turpentine, dest. dist	gal.	1.12	— .70
Pine tar pitch, bbl	200 lb.	.....	— 6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	.....	— 9.50
Retort tar, bbl	500 lb.		— 9.00
Rosin oil, first run	gal.	.38	— ....
Rosin oil, second run	gal.	.41	— ....
Rosin oil, third run	gal.	.48	— ....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		1.00
Pine oil, pure, dest. dist	gal.		.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

Quotations remain unchanged

Crude Rubber

Para—Upriver fine	lb.	$0.19	— .19½
Upriver coarse	lb.	.14	— .14½
Upriver caucho ball	lb.	.14	— .14½
Plantation—First latex crepe	lb.	.17½	— .17½
Ribbed smoked sheets	lb.	.17½	— .17½
Brown crepe, thin, clean	lb.	.15½	— .16
Amber crepe No. 1	lb.	.15½	— .16

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12½	— $0.13
Castor oil, AA, in bbls	lb.	.13	— .13½
China wood oil, in bbls	lb.	.12½	— .13
Cocoanut oil, Ceylon grade, in bbls	lb.	.08½	— .08¾
Cocoanut oil, Cochin grade, in bbls	lb.	.08¾	— .09
Corn oil, crude, in bbls	lb.	.08¾	— .09
Cottonseed oil, crude (f. o. b. mill)	lb.	.07½	— .07¾
Cottonseed oil, summer yellow	lb.	.10	— .10½
Cottonseed oil, winter yellow	lb.	.11	— .11½
Linseed oil, raw, car lots (domestic)	gal.	.87	— .88
Linseed oil, raw, tank cars (domestic)	gal.	.84	— .85
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.90	— .91
Olive oil, denatured	gal.	1.15	— 1.17
Palm, Lagos	lb.	.07	— .07½
Palm, Niger	lb.	.06½	— .06½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08¾	— .09
Peanut oil, refined, in bbls	lb.	.12½	— .12½
Rapeseed oil, refined in bbls	gal.	.78	— .80
Rapeseed oil, blown, in bbls	gal.	.86	— .87
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½	— ....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.08½	— .09

FISH

Light pressed menhaden	gal.	$0.51	— ....
White bleached menhaden	gal.	.54	— .55
Blown menhaden	gal.	.61	— ....
Whale Oil, No. 1, crude, tanks, coast	gal.	.45	— .48

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$600.00	$800.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	65.00	— 80.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	15.00	— 17.00
Barytes, ground, white, f.o.b. mills	net ton	17.00	— 23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00	— 21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00	— 24.00
Barytes, crude f.o.b. mines	net ton	8.00	— 9.00
Casein	lb.	.10½	— .13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00	— 8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00	— 9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00	— 20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00	— 12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00	— 20.00
China clay (kaolin), imported, lump	net ton	16.00	— 20.00
China clay (kaolin), imported, powdered	net ton	30.00	— 35.00
Feldspar, No. 1 pottery grade	long ton	7.00	— 7.50
Feldspar, No. 2 pottery grade	long ton	5.75	— 5.90
Feldspar, No. 1 soap grade	long ton	7.00	— 7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00	— 22 00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05	— .05½
Graphite, Ceylon chip	lb.	.04	— 04½
Graphite, high grade amorphous crude	ton	35.00	— 50.00
Kieselguhr, f.o.b. mines, Cal	per ton	40.00	— ....
Kieselguhr, f.o.b. N. Y	per ton	50.00	— 55.00
Magnesite, crude, f.o.b. California mines	per ton	12.00	— 15.00
Pumice stone, imported	lb.	.03	— .05½
Pumice stone, domestic, lump	lb.	.05	— .05
Pumice stone, domestic, ground	lb.	.06	— .07
Shellac, orange fine	lb.	.59	— .60
Shellac, orange superfine	lb.	.61	— .62
Shellac, A. C. garnet	lb.	.63	— .64
Shellac, T. N	lb.	.57	— .58
Silica, glass sand, f.o.b. Indiana	per ton	1.50	— 2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50	— 5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16.00	— 16.00
Silica, building sand, f.o.b. Pa	per ton	2.00	— 2.75
Soapstone	ton	12.00	— 15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00	— 12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50	— 12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	15.00	— 17.00

Refractories

Prices remain quotably unchanged

Ferro-Alloys

Prices remain same as previous report

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00	— $9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00	— 23.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	19.00	— 20.00
Coke, foundry, f.o.b. ovens	net ton	13.50	— 14 00
Coke, furnace, f.o.b. ovens	net ton	12.00	— 12.50
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15 00	— ....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50	— 19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½	— .01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45	— ....
Manganese ore, chemical (MnO_2)	net ton	70.00	— 75.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.80	— .85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00	— .....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½	— .11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12	— .13½
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12	— .....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.00	— 8.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C	unit	7.75	— 8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25	— 1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25	— 2.50
Vanadium pentoxide, 99%	lb.	12.00	— 14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00	— ....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½	— .13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

		Cents per Lb.
Copper, electrolytic		13.95–14.00
Aluminum, 98 to 99 per cent		20.00–21 00
Antimony, wholesale lots, Chinese and Japanese		6.85–7.00
Nickel, ordinary (ingot)		38.00
Nickel, electrolytic		39.00
Nickel, electrolytic, resale		32.00–33 00
Nickel, ingot and shot, resale		30.00–31.00
Monel metal, shot and blocks		32.00
Monel metal, ingots		35.00
Monel metal, sheet bars		38 00
Tin, 5-ton lots, Straits		33.75
Lead, New York, spot		6.50
Lead, E. St. Louis, spot		6.30
Zinc, spot, New York		6.95
Zinc, spot, E. St. Louis		6.625

OTHER METALS

Silver (commercial)	oz.	$0.69¼
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.35@2.40
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$112.00
Iridium	oz.	275.00@300.00
Palladium	oz.	55.00
Mercury	75 lb.	73.00

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

GLASS—The Alliance Window Glass Co., Salem, W. Va., has arranged for the resumption of operations at its plant, giving employment to more than 150 men.

The Turner Brothers Glass Products Mfg. Co., Terre Haute, Ind., has resumed production in its bottle-manufacturing department, after an idleness of about 8 weeks. The company will give immediate employment to about 175 additional operatives, making a total working force of about 300 persons. It is expected to maintain capacity operations for an indefinite period.

The Salem Co-operative Window Glass Co., Salem, W. Va., has resumed production at its plant, after a curtailment for a number of weeks.

LEATHER—Tanneries at Wilmington, Del., are rapidly increasing their production schedules, and a number of plants have added to their working forces during the past few weeks. The Christiania Leather Co. has resumed operations after an extended curtailment on a basis of about 100 dozen skins per day; it is expected to increase this schedule to 200 dozen at an early date. The Standard Kid Mfg. Co. is running under heavy output, specializing in colored kid. The Amalgamated Leathers Co. is making machinery improvements and repairs and plans to resume active production at an early date. William Beadenkopf has opened his local glazed kid plant, giving employment to a good working force. The Union Leather Co. is maintaining active manufacture and expects to continue practically at capacity for an indefinite period. The Delmarvia Leather Co., specializing in the production of glazed kid, has recently resumed operations at its plant, with good working force.

The J. H. Ladew Co., Newark, N. J., is now running at about 80 per cent of normal, devoting the output to high-grade sole leather.

RUBBER—The Lambert Tire & Rubber Co., Barberton, O., has advanced production to about double that heretofore scheduled, and is now running on a basis of about 350 cushion tires per day. This is the second increase made in manufacture by the company since the first of the year. The working force has been materially enlarged.

The Hood Rubber Co., Watertown, Mass., is running under heavy capacity at its tire-manufacturing plant, giving employment to a normal working force. Unfilled orders on hand insure continuance on the present basis, it is said, for some time to come.

METALS—The Callahan Zinc-Lead Co., Cœur d'Alene, Idaho, is arranging for the immediate resumption of operations. The local mill is being made ready, with machinery and other repairs now nearing completion.

The Chino Copper Co., Silver City, N. M., is maintaining active operations at its local plant, giving employment to a large working force. Wages have been increased 10 per cent, effective Oct. 1.

The Utah Copper Co., Bingham, Utah, is advancing production at its plants in this section. The wage schedule has been increased for laborers and workmen 40 and 50 cents per day, respectively. Other wage advances for skilled men are expected to be made at an early date.

The American Steel Foundries, Inc., Chicago, Ill., has advanced production at its plants to about 80 per cent of capacity.

IRON AND STEEL—The Reading Iron Co., Reading, Pa., is continuing the resumption of production in its different plant departments and has now placed its local No. 1 puddling mill in service, following a suspension for almost 2 years. The plant has been completely rebuilt; it consists of 8 double furnaces and will give employment to about 150 men.

The National Tube Co., Pittsburgh, Pa., has blown in the fifth and last blast furnace at its Lorain, O., plant, placing the works on a 100 per cent operating basis for the first time in nearly 2 years.

The Shenango Furnace Co., Sharon, Pa., has blown in its No. 4 blast furnace, after a long period of suspension.

The Virginia Iron, Coal & Coke Co., Roanoke, Va., is arranging for the early resumption of its blast furnace at Max Meadows; the plant has been idle for more than 18 months. The company is also planning to blow in its other furnaces at Roanoke and at Big Stone Gap.

The Bethlehem Steel Co. has blown in a fifth blast furnace at its Lackawanna plant at Buffalo, N. Y.

The Eastern Steel Co., Pottsville, Pa., is planning to blow in another blast furnace at its plant at an early date.

The Allegheny Ore & Iron Co., Irongate, Va., is planning to blow in its Buena Vista blast furnace before the close of the month.

The Wickwire Steel Co., Buffalo, N. Y., is completing the relining of a blast furnace at its local plant, and will place the unit in blast at an early date.

MISCELLANEOUS—The Edison Portland Cement Co., Edison, N. J., is running full at its local mills. A wage increase of 5c. an hour has recently been placed into effect, making a total advance of 60 per cent over the pre-war wage scale at the plant. About 600 employees are now on the payroll.

The U-Rub-It Chemical Co., Philadelphia, Pa., has completed the establishment of a new plant at 1208 South 23rd St., and has placed the factory in service on a full production schedule.

The Mexican Candelilla Wax Co., Torreon, Mexico, and a number of other candelilla wax-manufacturing plants in the States of Coahuila and Nuevo Leon, Mexico, have resumed operations after a shut-down for a number of years. The wax is extracted from the candelilla weed.

The Heyden Chemical Co., Garfield, N. J., manufacturer of salicylic acid, salicylate, etc., is completing the rebuilding of its local plant, destroyed by fire last year. The factory will be placed immediately in operation with a regular working force.

The Sherwin-Williams Co. of Canada, Montreal, Que., is advancing production at its paint and varnish plants. A 20 per cent increase has been recorded during the past year, as compared with the previous twelve-month.

Construction and Operation

Alabama

MOBILE—A 1-story foundry will be erected at the plant of the Mobile Pulley & Machine Works, to be equipped for the production of steel castings. Plans are being completed.

California

SAN FRANCISCO—The Los Angeles Soap Co., 633 East 1st St., Los Angeles, manufacturer of soap, washing powders, sal soda, etc., will take bids at once for the erection of a 2-story and basement plant at 2nd and Brannan Sts., San Francisco, estimated to cost about $80,000, including equipment. W. H. Crim, Jr., 425 Kearny St., San Francisco, is architect.

BERKELEY—The El Dorado Oil Co., University Ave. and 3rd St., will commence immediately the erection of a 2 story addition to its oil works, to cost about $13,000.

SANTA MONICA—The Santa Monica Brick Co. has construction in progress on a new plant at 24th St. and Michigan Ave., to be equipped for an initial production of about 40,000 bricks per day. The company was organized recently. M. J. Carlton is general manager.

HAYWARD—The Concrete Lumber Co., Los Angeles, has tentative plans under consideration for the establishment of a new plant at Hayward. A site will be selected at an early date.

Colorado

WHITE RIVER CITY—The Rio Blanco Carbon Co., 818 Symres Bldg., Erie, Pa., has plans under way for the erection of a new plant at Rio Blanco, White River City, consisting of three main buildings for carbon production, estimated to cost close to $75,000. O. D. Horton, 714 Commerce Bldg., Erie, is engineer. Thomas J. Dixon is president.

Connecticut

MILFORD—The Pruven Composition Products Co., recently organized under Delaware laws with capital of $250,000, is completing the remodeling of the local factory of the Askan Rubber Co., lately acquired, and will equip the plant for the manufacture of composition products, to be used as a substitute for hard rubber. It is expected to give employment to about 50 men for initial operations and this number will be increased at a later date. John J. Sharo is president.

Georgia

QUIMTAN—Construction has been commenced on an addition to the foundry at the plant of the Southern Machinery Co., to double, approximately, the present capacity. F. C. Underwood is president and general manager.

Kentucky

RUSSELLVILLE—The Independent Nitro Co., recently organized, has awarded a contract to John H. Berry, Union City, Ky., for the erection of a new local plant for the manufacture of nitroglycerine and kindred products. D. W. Kennedy, Richmond, Va., is president, and Stone W. Norman, secretary.

WILLIAMSBURG—The Iroquois Natural Gas Co., Iroquois Bldg., Buffalo, N. Y., is reported to be planning for the erection of a local plant for the manufacture of carbon black and kindred products, estimated to cost about $200,000, including machinery. Walter Simpson is president.

Louisiana

MONROE—The Monroe Glass Co., recently organized, has acquired property at Terminal Heights, a suburb of the city, as a site for the erection of its proposed new plant for the manufacture of blown glass products. The initial works will cost about $25,000, and are expected to be ready for operation by the close of the year. John Hartman, Alexandria, La., is vice-president in charge.

LAFAYETTE—The Peoples Cotton Oil Co., is planning for the rebuilding of the portion of its plant recently destroyed by fire. The new structure will be 150x200 ft. T. M. Biossat is vice-president and general manager.

Maryland

BALTIMORE—The United Lead Co., 827 South Howard St., has filed plans for the erection of a new 2-story building at its plant, 34x155 ft., estimated to cost about $40,000. The construction contract has been awarded to the Consolidated Engineering Co., Calvert Bldg.

Massachusetts

ALLSTON—The Atlantic Refining Co., 248 Boylston St., Boston, with headquarters at 3144 Passyunk Ave., Philadelphia, Pa., has awarded a contract to Metzger, Fisher & White, Otis Bldg., Philadelphia, for the erection of a new building, 2-story, 100x200 ft., at 52 Cambridge St., Allston, estimated to cost about $50,000.

SALEM—Baker & Kimball, 28 South St., Boston, have completed plans and will commence the immediate erection of their proposed new leather-manufacturing plant on property recently acquired at 5 Fort Ave., Salem, to be 2-story, 70x175 ft., and estimated to cost about $40,000.

Michigan

FLAT ROCK—The Ford Motor Co., Highland Park, is completing plans and will soon take bids for the erection of its proposed new plant at Flat Rock for the manufacture of sheet glass, for windshield and other service. It will be 1-story, 258x760 ft., and is estimated to cost close to $1,500,000, including machinery. Albert Kahn, 1000 Marquette Bldg., Detroit, is architect. The same architect is now taking bids for the construction of a new steel and steel alloy laboratory for the company at Dearborn, Mich.

Mississippi

CANTON—John T. Sharp, Jr., has preliminary plans under way for the establishment of a local plant for the manufacture of brick and affiliated burned clay products. Inquiries are being made for machinery and equipment.

Missouri

KANSAS CITY—The Vulcanite Roofing Co., 12th and Crystal Sts., manufacturer of composition roofing products, has construction in progress on a 1-story addition to its local plant, estimated to cost about $25,000. The company is a subsidiary of the Beaverboard Companies, Inc., Buffalo, N. Y.

MILAN—The City Council has plans in progress for the installation of a new filtration plant at the municipal waterworks.

New Hampshire

PLAISTOW—The Merrimac Clay Products Co., Inc., Room 609, 185 Devonshire St., Boston, Mass., will soon break ground for the erection of a new plant at Plaistow, for the manufacture of a line of burned clay products, to comprise a main 1- and 2-story works, 200x600 ft., estimated to cost about $250,000, including machinery. Morse & Chase, 25 Washington Sq., Haverhill, Mass., are architects.

New Jersey

EAST MILLSTONE—Fire, Oct. 2, destroyed a portion of the fertilizer mill of Fred Bascom, with other property in the immediate vicinity, resulting in a total loss of about $50,000. It is planned to rebuild.

JERSEY CITY—The Ault & Wiborg Co., 12th St., manufacturer of printing inks, etc., will make extensions in its tankage department at 307 13th St., estimated to cost about $12,000.

New York

PEEKSKILL—The Fleischmann Co., 701 Washington St., New York, is taking bids for the rebuilding of the portion of its local yeast-manufacturing plant, recently destroyed by fire.

LONG ISLAND CITY—The Abbey Effervescent Salt Co., Inc., 1382 Broadway, New York, has leased a floor in the new building on Rawson St., near Queens Boulevard, Long Island City, for the establishment of a branch plant for the manufacture of effervescent salts and kindred specialties.

Ohio

AKRON—The Rote Leather Co., recently organized under Delaware laws with a capital of $1,000,000, has acquired the plant of the Doyle Rubber Co., near the city limits, erected about 2 years ago but never occupied. The new owner will commence immediately the installation of machinery for the manufacture of imitation leather products for automobile tops and other service, and purposes to have the works ready for operation by the first of the year. B. W. Rote is president, and J. W. Hildebrand, secretary.

LIMA—The Buckeye Casting Co., specializing in the production of gray iron castings, has construction in progress on a 1-story foundry addition, consisting of two adjoining structures, each 40x40 ft., estimated to cost about $75,000, including equipment. John Sonnerbaum is president.

NORTH AKRON—The International Lead Co., a subsidiary of the Anaconda Copper Co., 25 Broadway, New York, has completed foundations for its proposed new local plant for the manufacture of zinc oxide and affiliated products, and will commence superstructure work at once. The entire plant, with machinery, is estimated to cost in excess of $750,000.

Pennsylvania

TRAINER—The Sinclair Consolidated Oil Corp., 45 Nassau St., New York, will break ground at once for the erection of a new oil-refining plant at Trainer, near Chester, on a 300-acre site recently purchased. The initial plant will consist of a number of buildings, equipped to give employment to close to 700 operatives, with storage department to consist of 15 steel tanks, each of 55,000-gal. capacity. It will cost about $2,000,000, with machinery. At a later date it is proposed to extend the plant to practically twice the size, with aggregate investment to approximate $5,000,000.

PHILADELPHIA—The General Paper Products Co., 10th and Diamond Sts., is taking bids for the erection of a 2-story plant addition, 30x68 ft., to be located at 3430 Lancaster Ave. James C. S. Fernald, 5533 Wyalusing Ave., is architect.

PHILADELPHIA—The M. L. Shoemaker Fertilizer Co., Venango St. and the Delaware River, has completed plans and will commence the immediate rebuilding of the portion of its plant, recently destroyed by fire, estimated to cost about $100,000.

WHITE HAVEN—The Peerless Powder Co. is completing the erection of a new local plant, comprising a number of buildings, and purposes to commence operations at an early date. Employment will be given to about 100 persons.

PHILADELPHIA—The Franklin Sugar Refining Co. 125 South Orianna St., has acquired the group of buildings at Delaware Ave. and Reed St., heretofore held by the Spreckels Sugar Refining Co., for a consideration said to be $2,500,000. The plant will be used by the new owner for general production, providing necessary enlargements.

JEANETTE—The American Window Glass Co., Farmers' Bank Bldg., Pittsburgh, has awarded contract to the Heyl & Patterson Co., 51 Water St., Pittsburgh, for the construction of its proposed plant addition at Jeanette. The work will consist of a new 12-machine building and subsidiary departments, estimated to cost approximately $1,500,000. William L. Monro is president and general manager.

NEW CASTLE—The Grasselli Powder Co., Guardian Bldg., Cleveland, O., has commenced the construction of an addition to its dynamite-manufacturing plant at Covert Station, near New Castle, designed to double approximately the present capacity. The new extension will be equipped to give employment to about 100 operatives.

CASTLE SHANNON—The Pittsburgh Art Stone Co., 807 Jones Law Bldg., manufacturer of composition stone products, is taking bids for the construction of a new 1-story plant on local site, estimated to cost close to $30,000. D. C. Tabor is president.

South Carolina

GEORGETOWN—The former alcohol plant of the du Pont Powder Co., Wilmington, Del., was destroyed by fire, Sept. 26; an official estimate of loss has not been made. The plant has not been in operation for a number of months past, and it is not expected to rebuild.

Tennessee

CHATTANOOGA—The Abrasive Co., 30 Church St., New York, manufacturer of grinding wheels and other abrasive products, is reported to be planning for the construction of a new ore-reduction plant in the vicinity of Chattanooga. Raw material will be furnished from the company's mines at Adairsville, Ga. Henry M. Payne is consulting engineer.

Texas

EL PASO—The Tex-McCracken Concrete Pipe Co., 304 Trust Bldg., has plans under way for the construction of a new plant for the manufacture of concrete pipe and kindred products, on site selected on Stevens Ave., near Frutas St. It will consist of a number of buildings, and is estimated to cost approximately $75,000. H. E. Johnson is general manager.

HOUSTON—The Texas Tinners' Supply Co. is making inquiries for a quantity of machinery for the manufacture of seamless rubber products.

AMARILLO—F. J. Storm, Amarillo, and associates, are organizing a new company to construct and operate a gasoline extraction plant in the Amarillo gas field. A site has been selected and work will be begun immediately.

Virginia

GOSHEN—The Speer Sand Co. has plans under way for the construction of a new local plant for the manufacture of hollow cement blocks and other composition cement products. A list of equipment has been arranged. It is proposed to commence work at an early date.

Washington

TUMWATER—The West Coast Pulp & Paper Co., Salem, Wash., has acquired local buildings, heretofore occupied by the Phex Co., and will remodel the structure for the establishment of a new paper mill. Work will be commenced at an early date. C. M. Miall is president.

CONCRETE—The Superior Portland Cement Co. has awarded a contract to the Rounds-Clist Co., Walker Bldg., Seattle, for the construction of a 1-story plant addition, 125x250 ft., estimated to cost about $100,000.

West Virginia

WEIRTON—The Weirton Steel Co. has awarded a contract to the McClintic-Marshall Co., Oliver Bldg., Pittsburgh, Pa., for the construction of a new plant addition, estimated to cost approximately $1,500,000, with equipment. The work will consist of 12 new mills, for the manufacture of black and galvanized sheets; all equipment will be electrically operated. It is expected to have the plant ready for service early in May, 1923. D. M. Weir is vice-president.

Wisconsin

PORTAGE—The Ford Motor Co., Highland Park, Mich., is reported to be planning for the construction of a new zinc oxide plant in the vicinity of Portage, estimated to cost in excess of $500,000. The work will include a hydro-electric power plant to be located on the Wisconsin River. Preliminary surveys are in progress.

NEENAH—The Valley Paper Mills Inc., has awarded a contract to the Appleton Construction Co., Appleton, Wis., for foundation work for its proposed 1- and 2-story paper mill, 80x550 ft., on local site, Blair Springs district, estimated to cost about $100,000. Contract for superstructure will soon be let. G. W. Burnside is secretary and manager.

New Companies

THE DUCHARME CHEMICAL CO., INC., Bridgeport, Conn., has been incorporated with a capital of $20,000, to manufacture chemicals and chemical byproducts. The incorporators are Charles D. Boyd, John J. Hennessy and John G. Flood, 1400 Stratford Ave., Bridgeport.

THE ACKERMAN RUBBER CO., Paterson, N. J., has been incorporated with a capital of $250,000, to manufacture rubber products. The incorporators are L. M. and Wallace W. Seed, and Frank P. Ackerman, 39 Paterson St., Paterson.

THE NORTHWESTERN POTTERY CO., 5220 Norwood Park, Chicago, Ill., has been incorporated with a capital of $100,000, to manufacture earthenware products of various kinds. The incorporators are Richard C. Mazer, Edward C. Blanko and Albert W. Bookman.

THE ALBANY SOAP CORP., Albany, N. Y., has been incorporated with a capital of $90,000, to take over and merge the Three Points Products Corp. and the Christian Brothers Soap Co., both of Albany. The new company will manufacture soaps, washing powders, etc. The incorporators are J. H. Rea, J. Grober and J. Nicklas, all of Albany. The company is represented by Tobin, Wiswall & Walton, attorneys, Albany.

THE BENTON CHEMICAL CO., INC., 113 Water St., Baltimore, Md., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture chemicals and chemical byproducts. The incorporators are Gordon Eaton, Eugene Frederick and Henry C. Meusel.

THE ROANOKE GLASS CO., Roanoke, Va., has been incorporated with a capital of $100,000, to manufacture glass products. R. H. Angell is president, and C. R. Williams, secretary, both of Roanoke.

THE M. D. OIL CORP., Rochester, N. Y., care of Albright & Mepham, E. and B. Bldg., Rochester, representatives, has been incorporated with a capital of $150,000, to manufacture oil products. The incorporators are B. and F. Seaman, and C. Clark.

THE WATKINS CHEMICAL CO., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated with a capital of $200,000, under state laws, to manufacture chemicals and chemical byproducts.

THE BLACKFORD WINDOW GLASS CO., Vincennes, Ind., has been incorporated with a capital of $1,000,000, to take over and consolidate the Blackford Window Glass Co. and the Indiana Window Glass Co., both of Vincennes. The new organization will continue in the manufacture of sheet glass.

THE ARUNDEL SHOPE BRICK CO., Pier 2, Pratt St., Baltimore, Md., has been incorporated with a capital of $25,000, to manufacture concrete and cement bricks, blocks, etc. The incorporators are Lawson L. Wagner, Richard A. Froehlinger and Walter C. Mylander.

THE HITS-IT MFG. CO., Camden, N. J., care of the New Jersey Corporation Guarantee & Trust Co., 419 Market St., Camden, representative, has been incorporated with a capital of $125,000, to manufacture insecticides, chemical specialties, etc.

THE LONGLEY CHEMICAL CO., 6747 Chappel Ave., Chicago, Ill., has been incorporated with a capital of 201 shares of stock, no par value, to manufacture chemicals and chemical byproducts. The incorporators are John Longley, James A. Sell and Benjamin Kaufmann.

THE DENNY-MEXIA OIL CO., New York, N. Y., care of the United States Corporation

Co., 65 Cedar St., New York, representative, has been incorporated under Delaware laws, with capital of $5,000,000, to manufacture petroleum products.

THE CONCORD LIME CO., Concord, Tenn., has been incorporated with a capital of $10,000, to manufacture lime and affiliated products. The incorporators are H. G. and M. L. Winfrey, and O. L. White, all of Concord.

THE FALK CO., INC., Pittsburgh, Pa., care of Sachs & Caplan, 328 Frick Bldg., Pittsburgh, representatives, is being organized by Arthur C. Trask, Victor J. Poll and Louis J. Reizenstein, to manufacture oils, greases, tanning materials, etc. Application for a state charter will be made on Oct. 30.

THE CLIMAX OIL CO., care of the Corporation Guarantee & Trust Co., Land Title Bldg., Philadelphia, Pa., representative, has been incorporated under Delaware laws with capital of $1,500,000, to manufacture petroleum products.

THE COMMERCIAL TIRE CORP., Fort Wayne, Ind., has been incorporated with a capital of $75,000, to manufacture automobile tires and rubber accessories. The incorporators are Harold H. Bieber, C. Platt Squires and Morton M. Hathaway, all of Fort Wayne.

THE JOHN G. BEEKLER CO., 659 Hobbie St., Chicago, Ill., has been organized under state laws to operate a chemical research laboratory, manufacture chemical specialties, etc. The company is headed by Charles O. and Ralph Sethness.

THE PAN-AMERICAN PRODUCTS CORP., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, representative, has been incorporated under Delaware laws, with capital of $2,500,000, to operate a tannery and manufacture leather goods.

THE FLORIDA DEHYDRATION CO., Jacksonville, Fla., has been incorporated with a capital of $75,000, to construct and operate a local dehydration pant. Hugh S. Grainger is president; and M. H. Weaver, secretary, both of Jacksonvile.

THE BOYD OIL CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under state laws with a capital of $2,000,000, to manufacture petroleum products.

THE SENECA FOUNDRY CO., Waterloo, N. Y., care of W. S. O'Brien, Geneva, N. Y., representative, has been incorporated with a capital of $25,000, to manufacture iron, steel and other metal castings. The incorporators are J. and J. F. Madia, and C. Cannull, Waterloo.

LOUIS F. GUERRE & CO., INC., New Orleans, La., has been organized under state laws to manufacture waterproof roofing cements, paints, etc. The incorporators are Louis Guerre and Fitch H. Kelly, both of New Orleans.

THE PERFECT PRODUCTS CO., of Huntsville, Ala., has been incorporated with a capital stock of $100,000, to manufacture oxalic acid. The incorporators are T. W. Pratt (president the West Huntsville Cotton Mills Co.), Dr. C. A. Grote, W. S. Dillworth, Kenneth Martin and H. D. Rankin. The main office and plants are located at 415 Meridian St., Huntsville, Ala.

H. B. BERCOW & CO., 15 Park Row, New York City, has been incorporated with a capital of $20,000, to trade in chemicals and allied products. The incorporators are H. B. Bercow, R. Josephi and A. Arendt. The attorney is B. F. Kraft, 59 Wall St., New York City.

THE URADINA CHEMICAL CORP., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., New York, representative, has been incorporated under Delaware laws with capital of $1,000,000, to manufacture chemicals and chemical byproducts.

THE SEABOARD FOUNDERS, INC., Brooklyn, N. Y., care of Fowler & Lesser, 126 Liberty St., New York, representatives, has been incorporated with a capital of $110,000, to manufacture iron, steel and other metal castings. The incorporators are R. J. West, J. C. Garrett and H. W. Eldred.

THE PACIFIC BRICK & TILE CO., 4600 Alhambra Ave., Los Angeles, Calif., has filed notice of organization to manufacture brick, tile and kindred burned clay products. The company is headed by Carl B. Gallasch.

THE CONSUMERS' OIL CORP., Union Hill, N. J., has been incorporated with a capital of $100,000, to manufacture oil products. The incorporators are Charles Killcast, George and Herman Koch, 575 Jefferson Place, Union Hill. The last noted represents the company.

THE ERCUTO CORP., Rochester, N. Y., has been incorporated with a capital of $50,000, to manufacture chemicals, dyestuffs and affiliated products. George B. Tucker, 110 Harvard St., Rochester, is the principal incorporator.

THE WEBB-DIMMITT OIL CORP., San Antonio, Tex., has been incorporated with a capital of $150,000, to manufacture petroleum products. The incorporators are M. L. Cummings, P. W. Carbusier and J. J. Laas, all of San Antonio.

Capital Increases, etc.

THE PENNSYLVANIA INDEPENDENT OIL CO., Allentown, Pa., has filed notice of increase in capital from $200,000 to $1,000,000.

Frederick M. Woolley has been appointed receiver for the AMERICAN DYE INTERMEDIATES CO., Newark, N. J.

THE AMERICAN SPONGE & CHAMOIS CO., 47 Ann St., New York, N. Y., has filed notice of increase in capital from $150,000 to $500,000, for proposed expansion.

THE CONTINENTAL MINES, LTD., Toronto, Ont., operating gold and silver properties and plants, is disposing of a stock issue of $1,250,000, a portion of the proceeds to be used for expansion, etc. R. C. Warriner is president.

THE PRESTON CHEMICAL CO., 180 4th Ave., Brooklyn, N. Y., has arranged for an increase in capital from $30,000 to $50,000.

THE BRIER HILL STEEL CO., Youngstown, O., is disposing of a bond issue of $10,000,000, a portion of the proceeds to be used for plant extensions. James B. Kennedy is chairman of the board.

A petition in bankruptcy has been filed against the STANDARD MINING & CHEMICAL WORKS, INC., Newark, N. J. The liabilities and assets are not stated.

New Publications

MELLON INSTITUTE OF INDUSTRIAL RESEARCH has issued Bull. 1, Bibliographic Series, which gives a list of the books, bulletins, journal contributions and patents by members of Mellon Institute of Industrial Research, 1911-1922.

PETROLEUM POSSIBILITIES OF CERTAIN ANTICLINES IN SOUTHEASTERN IDAHO. By Virgil R. D. Kirkham. Bull. 4, Bureau of Mines and Geology, State of Idaho, Moscow, Idaho.

WOOD-PRESERVING TERMS. By Ernest F. Hartman and E. F. Paddock. Published by the Protexol Corp., New York. Price $1.

ELECTRICAL HEATING REFERENCE DATA. Published by the Electrical Alloy Co., Morristown, N. J. This copyrighted publication embodies the experience and suggestions of an expert on electrical heating.

WATER-GLASS (A Bibliography). Compiled by Morris Schrero. Published by the Carnegie Library of Pittsburgh, Pittsburgh, Pa. Price 15c.

THE EFFECT OF IMPURITIES ON THE OXIDATION AND SWELLING OF ZINC ALUMINUM ALLOYS. A research bulletin, issued by the New Jersey Zinc Co.

TRADE STANDARDS IN THE PUMP INDUSTRY, recommended by the Hydraulic Society, 1922, and prepared by C. H. Rohrbach, secretary, 50 Church St., New York City.

IMPERIAL MINERAL RESOURCES BUREAU PUBLICATIONS: Vanadium (1913-1919), price 6d.; Quicksilver (1913-1919), price 1s.: Iron Ore (summary of information as to the present and prospective iron-ore supplies of the world), price 6s.

NEW BUREAU OF MINES PUBLICATIONS: Bull. 192 Carbon Black—Its Manufacture, Properties and Uses, by R. O. Neal and G. St. J. Perrott; Bull. 199, Experimental Production of Alloy Steels, by H. W. Gillett and F. L. Mack: Tech. Paper 188, Corrosion Under Oil Films, With Special Reference to the Cause and Prevention of the After-Corrosion of Firearms, by Wilbert J. Huff; Tech. Paper 276, Safe Mechanical Equipment for Use in Shaft Sinking, by R. H. Kudlich; Tech. Paper 277, Application of the Geophone to Mining Operations, by Alan Leighton; Tech. Paper 285, Compressed-Air Illness and Its Engineering Importance, With a Report of Cases at the East River Tunnels, by Edward Levy; Tech. Paper 290, Inclusions in Aluminum-Alloy Sand Castings, by R. J. Anderson; Tech. Paper 292, Tests of Gas Masks and Respirators for Protection for Locomotive Smoke in Railroad Tunnels, With Analyses of Tunnel Atmospheres, by A. C. Fieldner, S. H. Katz and S. P. Kinney; Tech. Paper 302, Coal-Mine Fatalities in the United States, 1921, by William W. Adams; Tech. Paper 307, Permissible Explosives, Mining Equipment and Apparatus Approved Prior to March 15, 1922, by S. P. Howell, L. C. Ilsley, D. J. Parker and A. C. Fieldner; Tech. Paper 311, Factors in the Spontaneous Combustion of Coal, by O. P. Hood.

NEW BUREAU OF STANDARDS PUBLICATIONS (U. S. Government specifications): Circ. 82, For Linseed Oil, Raw, Refined and Boiled: Circ. 84, For Basic Carbonate White Lead, Dry and Paste; Circ. 85, for Basic Sulphate White Lead, Dry and Paste; Circ. 87, for Zinc Oxide, Dry and Paste; Circ. 88, for Leaded Zinc Oxide, Dry and Paste; Circ. 89, for White Paint and Tinted Paints Made on a White Base, Semi-Paste and Ready Mixed; Circ. 93, for Iron-Oxide and Iron-Hydroxide Paints; Circ. 103, for Water-Resisting Spar Varnish; Circ. 123, for White Floating Soap; Circ. 124, for Liquid Soap; Circ. 125, for Soap Powder; Circ. 126, for Salt Water Soap; Circ. 127, for Automobile Soap; Circ. 128, for Chip Soap; Circ. 129, for Ordinary Laundry Soap; Circ. 130, for Grit Cake Soap; Circ. 131, for Scouring Compounds (*a*) and (*b*), for Floors and Soap-Scouring Compounds (*c*); Circ. 132, for Hand Grit Soap.

OTHER BUREAU OF STANDARDS PUBLICATIONS: Sci. Paper 440, The Spectral Transmissive Properties of Dyes: Seven Permitted Food Dyes in the Visible, Ultra-Violet and Near Infra-Red, by K. S. Gibson, H. J. McNicholas, E. P. T. Tyndall and M. K. Frehafer of the Bureau of Standards, with the co-operation of W. E. Mathewson of the Bureau of Chemistry, price 15c.; Sci. Paper 443, Measurement of the Color Temperature of the More Efficient Artificial Light Sources by the Method of Rotary Dispersion, by Irwin G. Priest, price 5c.; Tech. Paper 211, Radiators for Aircraft Engines, by S. R. Parsons and D. R. Harper, price 50c.; Tech. Paper 212, Carbon Monoxide in the Products of Combustion From Natural Gas Burners, by I. V. Brumbaugh and G. W. Jones, price 10c.; Tech. Paper 214, Durability of Cement Drain Tile and Concrete in Alkali Soils (Third Progress Report, 1919-1920), by G. M. Williams, price 10c.

Coming Meetings and Events

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS will hold a 3-day national convention in New York, beginning Oct. 18. The general topic of the convention is "Economics of Industry."

TANNERS' COUNCIL will hold its annual meeting Oct. 19 and 20 at the Congress Hotel, Chicago.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, 52 East 41st St., New York City: Oct. 20—Society of Chemical Industry, Grasseli Medal. Nov. 10—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting. Nov. 17—American Electrochemical Society, regular meeting. Dec. 1—Society of Chemical Industry, regular meeting. Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.